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The Mine That Hears

By Edward F. Chandler

It is unnecessary to introduce Mr. Chandler to the readers of the POPULAR SCIENCE MONTHLY. *In the present article he describes another one of his remarkable applications of the microphone to naval weapons—an application which is based upon a ripe experience gained in the development of torpedoes and other inventions. The "Mine that Hears" is the result of several years of constant study and experiment by the author, and is described here in detail for the first time.*—EDITOR.

EVERY one knows that in time of war harbors are protected by mines through which an enemy cannot easily pass without the risk of destroying himself. Depending on their nature the mines are called "contact" or "shore-controlled." As the names indicate, the contact mine explodes as soon as a trigger with which it is provided is actuated by a ship, or a bottle of acid is spilled on a suitable chemical; the shore-controlled mine is exploded electrically from a station at the critical moment determined by observation.

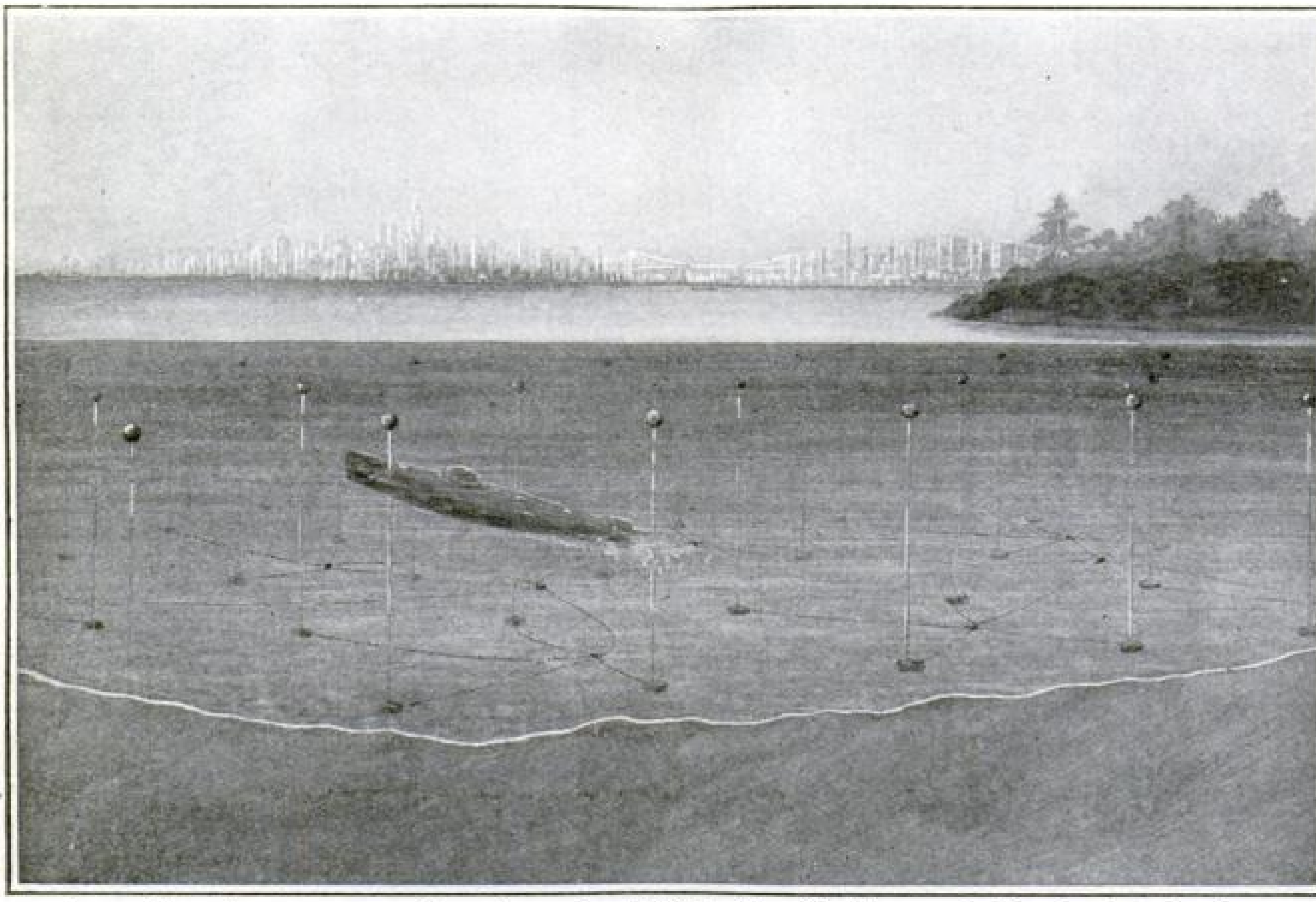
Of the two kinds the shore-controlled is the safer. The contact-mine may break loose and become a menace to neutral shipping, as the tragic incidents of the present war have abundantly shown.

The British Grand Fleet undoubtedly owes its safety in part to the submarine mine. It lies in harbors the entrances of which are sown with mines so thickly that a submarine could not worm its way through them without blowing itself up. Whether or not the feat of running through a mine-field has actually been performed in the war there is at least reason to believe that it has been attempted. Mr. Simon Lake, a leading authority on submarine boat construction in this country, not only declares that a submarine can penetrate a mine-field but has shown how it can be done. He has devised a special type of submarine provided with an antennalike projection or "feeler" in front, which enables a submarine commander to push aside mines with reasonable safety.

If the Lake and similar systems are able to perform their functions it is obvious that no harbor is absolutely safe from submarines. In previous articles published in the POPULAR SCIENCE MONTHLY, I have shown how torpedoes can be automatically steered toward ships, which they are intended to destroy, by employing microphones to pick up the propeller vibrations, and how submarine boats, which are notoriously blind under water, can be directed accurately toward a hostile vessel by the same means. I have worked out a method of applying microphones to mines, which, it seems to me, makes it quite impossible for a submarine to enter a mine-sown harbor, and which also enables the officer in command of a station from which shore-controlled mines are fired to detect the attempt of a surface vessel to enter under the cloak of a dense fog.

The system which I have devised would render it possible to blow up a submarine trying to worm its way into a mine-protected harbor, or a battleship

g to enter a harbor at night or in ...nse fog. In my system the mines ... arranged in groups of four, each group constituting a field unit. On each mine a microphone is mounted.* These microphones literally hear the hum of a submarine's motor. Not only that but the particular microphone which hears the submarine best, because it is the



As a submarine progresses through a mine-field in the effort to reach shipping in a harbor, the hum of its electric motor is heard by microphones on the mines. The vibrations picked up by the microphones are electrically transmitted to shore and converted into visual signals by incandescent lamps corresponding in number and position with the microphoned mines

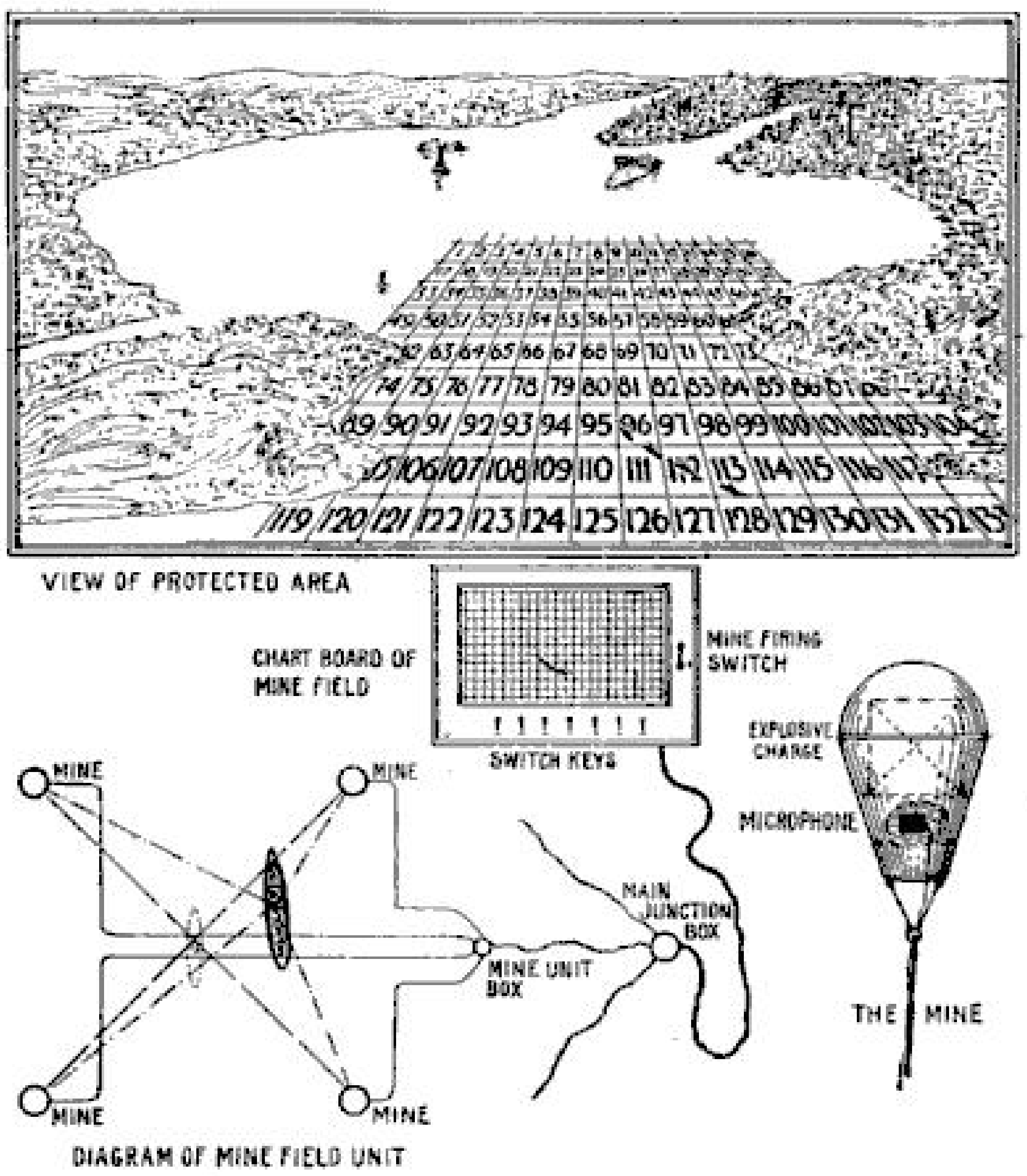
nearest to it, can easily be located. It is simple enough to determine whether a submarine is nearer mine 1 or mine 2 of a given field unit of four mines.

The field units are interconnected electrically, so that the entire harbor is sown not only with charges of high explosive but with microphone detectors. Interconnection is necessary because mines 1 and 2 of one group constitute mines 3 and 4 of an adjacent group. Microphones are so remarkably sensitive (they have picked up the hum of submarines fifteen miles away in the present war) that they need not be lavishly employed in every case. Four microphones placed in the four corners of a small field would answer in many cases, all the more so, since a ship can be blown up even though it be fifty feet from the actual explosion. Few of us realize how terrific is the disruptive effect of the gases suddenly generated when several hundred pounds of explosive are detonated.

A mine-field equipped with microphones in the manner indicated is electrically connected with a luminous annunciator. In other words, wires run from each microphone to a board which is divided into squares correspond-

*For the benefit of those who may be unfamiliar with the microphone I may state that the microphone is an instrument for intensifying feeble sounds or for transmitting sounds and it is based on the principle that the transition between loosely-joined electrical conductors decreases in proportion as they are pressed together. The conductors form part of a circuit through which a current is passing, and the variations in pressure due to sound waves in the vicinity of the conductors produce variations of resistance and fluctuations of the current so that the sounds are reproduced in a telephone receiver. In the modern telephone the transmitter is essentially a microphone, the pressure of the sound waves being communicated to the conductors by means of a diaphragm.

ing in number with those of the mine-field units. Behind each square a lamp is mounted. As a hostile ship passes through a mine-field the nearest microphones pick up the vibrations of her propellers and the corresponding lamps on the board glow. The luminous annunciator may be twenty or more miles distant from the microphones; it may be in Chicago and the mine-field in New York Harbor, if there were any military advantage in that great separation. It is always possible to follow the course of an intruding vessel merely by watching the lights as they flare up and die out in the squares of the luminous annunciator. The lamps actually visualize the course taken by the vessel under observation. If she enters square 22 of the field the lamp behind square 22 on the annunciator board glows; as she slips into square 23 of the mine-field, lamp 22 is extinguished and lamp 23 flares up. The accompanying diagram will explain the general principle.



The mines, provided with microphones to hear the vibrations of ships which seek to enter a harbor, are arranged in numbered squares. A luminous indicator on shore, marked off into squares corresponding in number with those of the mines, is electrically connected with the microphones. Each mine-square is represented on the indicator by a lamp, which glows in its proper square on the luminous board as soon as a hostile ship enters and is heard. Thus it is possible to follow by the successive flaring up of lamps the course of a submarine or battleship threading its way through the mine-field and to explode the right mine

Mines are expensive. To provide them with microphones and to wire the microphones to a luminous annunciator board adds to the cost of the installation. Suppose that it were possible to use fewer mines, in other words, to use rather large squares, and suppose that it were possible to determine not merely the particular square into which a hostile vessel has found its way but the particular mine of that square nearest which it happens to be—would not that solve the problem of cheapening the installation and heightening its effectiveness?

With this idea in mind I have connected with the luminous annunciator board what may be called a "precision indicator," the purpose of which is to show which mine is to be exploded in order to destroy the interloper. A single precision indicator serves for all the mines; for the wiring is such that the precision indicator can be switched into the circuit of any mine-square at will. The details cannot be revealed at the present time, because they are the subject of a patent application awaiting official action. It may be stated, however, that the devices employed accurately locate a vessel in a square by averaging the momentary responsiveness of the four microphones at the corners of the square. It is very much as if a pencil were attached by four cords to as many pulling devices, the pull on each cord coming from a different point of the compass and representing the intensity of the sound heard in a microphone. Pulled in all

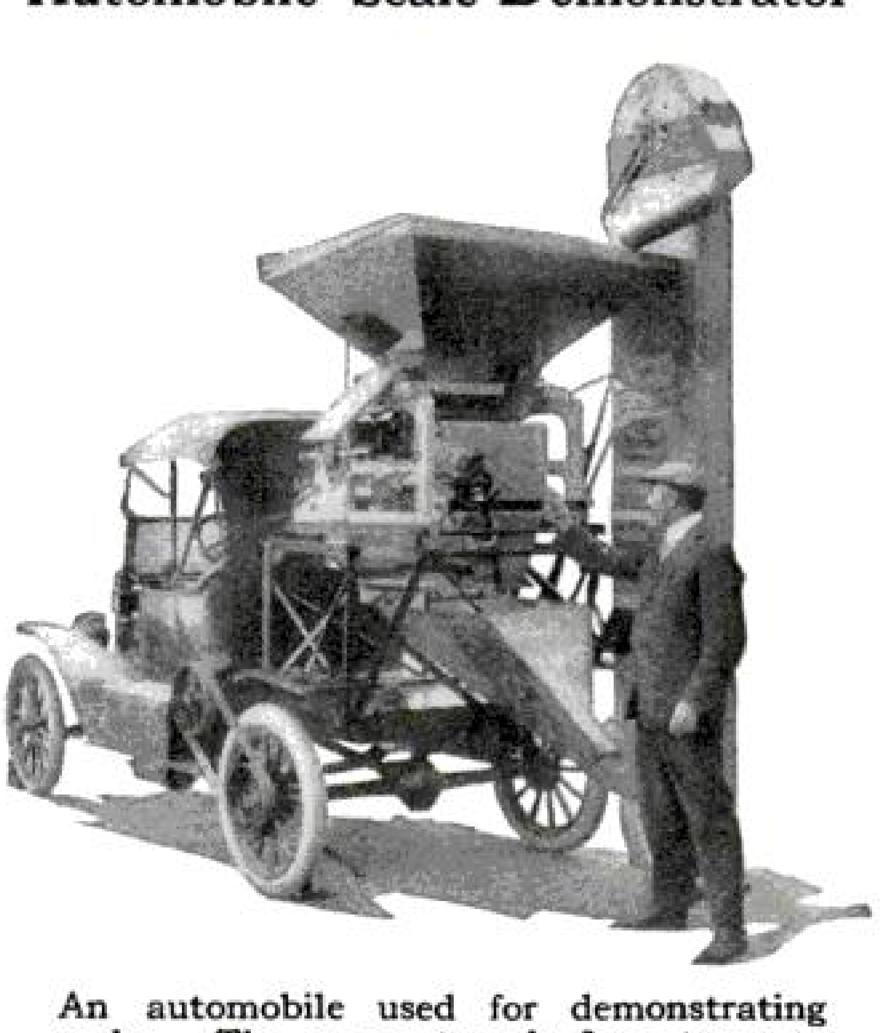
four directions at once, but with different intensities, the pencil will rest at that point where all the forces are equalized. That point, in the case of the precision indicator, is the spot in which the hostile vessel is to be found.

Imagine New York Harbor mined and microphoned in the manner that I have described; imagine the mines connected with a luminous annunciator at Fort Wadsworth and with a precision indicator provided for the purpose of determining which microphone in a square hears the most; imagine a submarine crawling very, very cautiously through the field, thrusting aside with careful antenna, the anchor-chains of the buoyant mines in its path. An American officer glues his eyes on the luminous board. One by one the squares glow before him—19, 36, 53, 66. Unwittingly the submarine's commander plots his course in a trail of light. He cannot be seen with human eyes; and yet he is as visible, electrically at least, as a goldfish in a glass bowl. "Square 78," says the American officer to himself, as a new light flashes up. The time has come for decisive action. He pulls a handle and switches the precision indicator into electrical connection with square 43. The submarine is nearest mine "A" of that unit, for the microphone on mine "A" is intensely active. He presses a button. Miles away a column of water is tossed into the air. An unseen enemy has been destroyed with awful suddenness; twenty brave sailors have been killed with merciful swiftness by a man who never saw their faces.

The naval and military strategist will note at once that the system which I have described has this advantage over the rather haphazard method of utilizing the contact mines at present employed. It renders it possible to destroy a whole fleet, ship by ship, as it progresses into a harbor which is protected. The officer at the luminous indicator board has only to wait until the lamps show that the entire squadron has entered the field to blow up ship after ship at his pleasure. It is also apparent that the system is not limited in its application to the detection of battleships or submarines in a mine-field, but that it can also be adapted to the firing of coast-defense shore-batteries.

Automobile Scale-Demonstrator

ON the principle that if you can't get the buyer to come to you, you will have to take your product to the buyer, a large manufacturer of scales for weighing grain recently fitted up one of his scales on a light automobile and sent it out through several of the western states as a demonstrator. As shown in the accompanying illustration, the car was fitted with a complete scale and in addition a portable elevator to raise the grain to the former, so that it really was a working model for the prospective buyer to inspect.

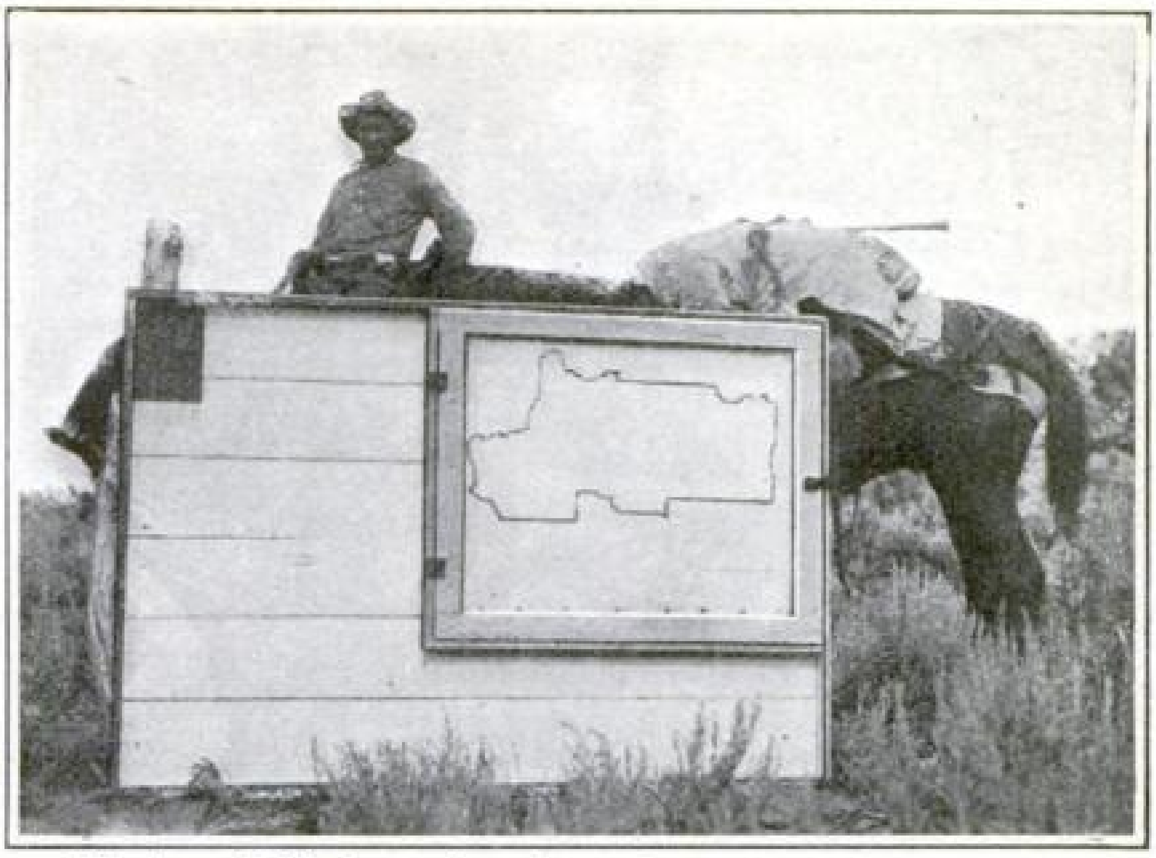


An automobile used for demonstrating scales. The owner travels from town to town, the scale enclosed in canvas and the portable elevator carried on the side

The car travels from town to town, the scale proper being enclosed in canvas enroute and the portable elevator is carried on the side. The power for driving the elevator is secured from the motor of the automobile.

The money-making ability of this outfit has been clearly shown.

Government Guide-Posts Give Detailed Information



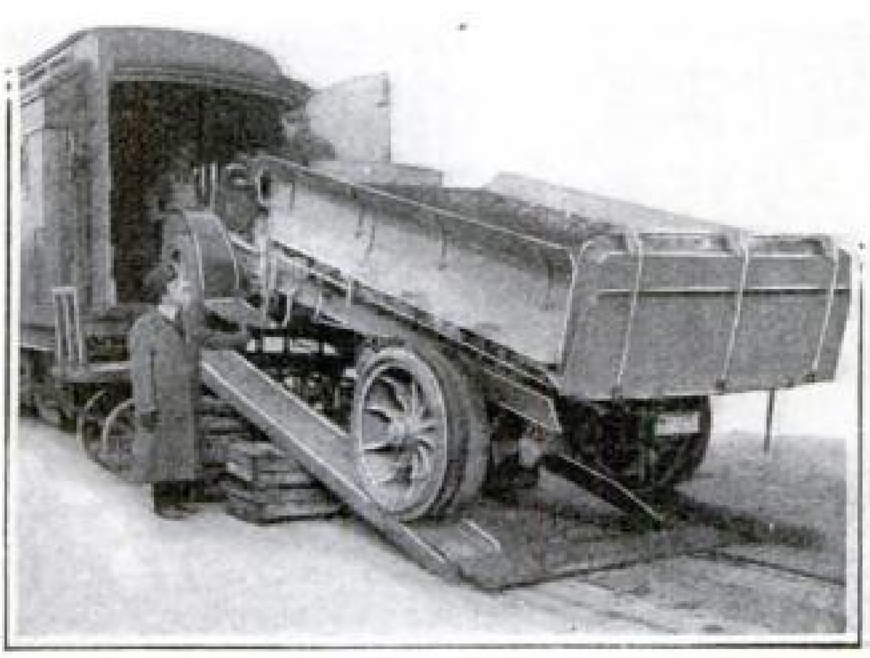
Much useful information about the surrounding country can be gained from these guide-posts

AS a guide to persons not familiar with the reservation, and as a means of conveying to strangers information with regard to its limits, there have been erected on the outskirts of the Ashley National Forest in Utah, at points where main roadways enter it, maps showing the boundaries, roads, trails, streams, lakes, and other points of interest within the forest. The maps are enclosed in glass-covered frames and are attached to sign-boards where copies of notices and regulations concerning the reservation are displayed.

On each map a tack indicates its position with regard to the reservation. The topographical features of the country also are indicated, as well as the location of the headquarters of the forest supervisor and of his numerous assistants. The maps have proved of great value to stock grazers and others desiring to know the boundaries of the forest.

End-Door Automobile Express Cars

FREQUENT recourse is made to the express service for shipping automobiles and motor trucks as rapidly as possible in emergency cases. Detroit manufacturers, for instance, usually send their new model cars in this way, employing special trains of eight and nine express cars for the purpose. The very best possible time is not too fast for purchasers of new model cars, who usually wait for their arrival in New York, gasoline can in hand, taking the cars as fast as they can be removed from the express trucks.



Cars with end-doors for shipping motor-trucks by express

One express company has employed specially constructed cars built with two swinging doors that permit loading from the end. Automobiles can be put into the cars under their own power on a rising platform, or they can be pushed in, on the level platform.

One of the largest trucks handled in an express car was a five-ton dumping cart, sent recently by a Los Angeles automobile concern to a mining company at Tucson, Arizona. On account of the high prices paid for all kinds of mineral, the mine operators were working their properties night and day.

Three hours after the order was received, the truck was loaded into an end-door express car by its own power and went out on a train leaving at 3 o'clock. The next morning, it reached Tucson, with an express charge of $400 attached. It was so badly needed that the first twenty-four hours' use of the truck paid for the transportation expenses.

When the "Guns" of Peace

Wrecking the Italian Towers at the Panama-Pacific Exposition grounds. The base

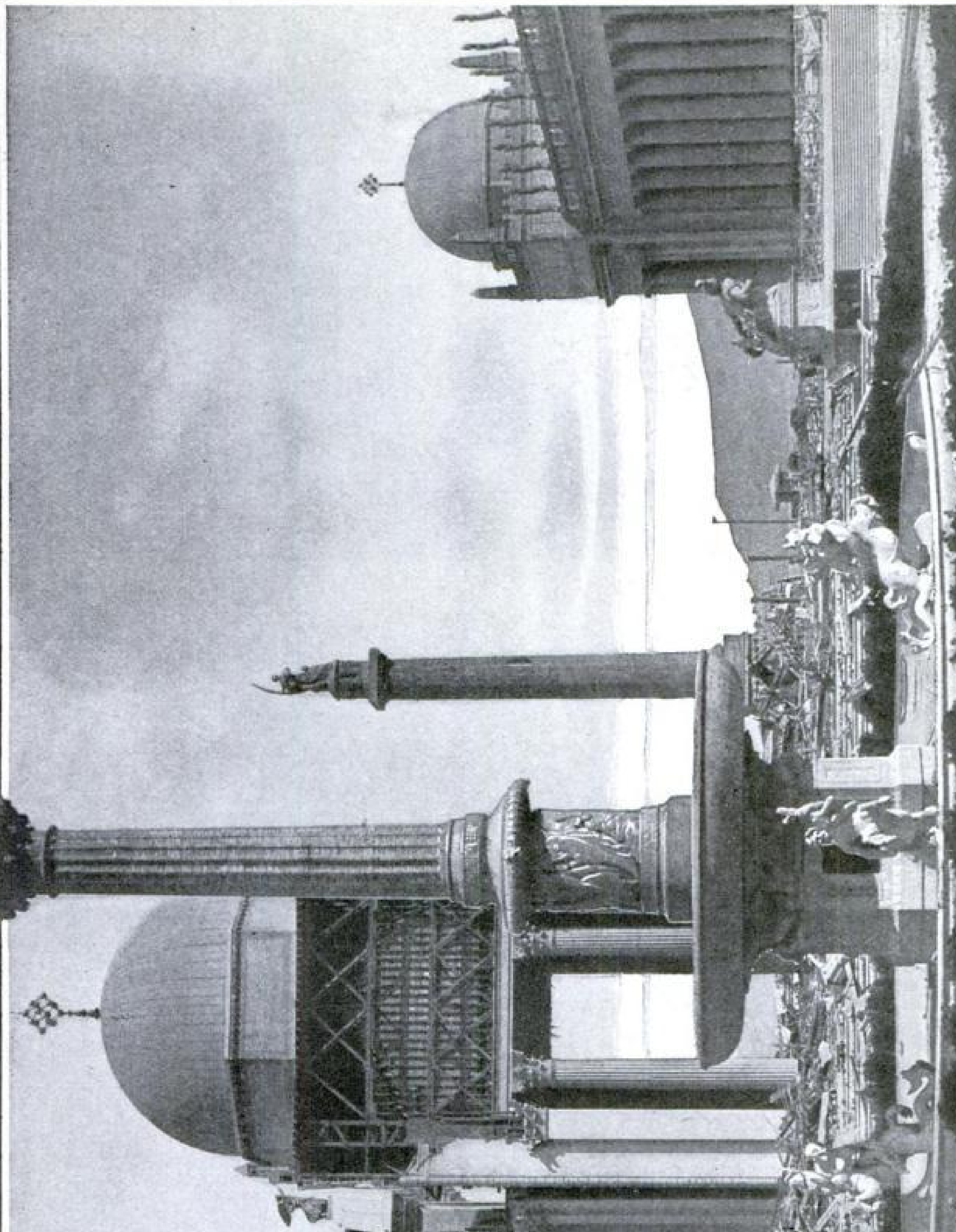
was dynamited and the big pillar crashed to earth, a mass of splintered wood

The Transit of Exposition Glories

Festival Hall was considered to be an acoustic masterpiece. When the great organ was removed to San Francisco's new art center the same dummy-engine that helped build the structure helped to destroy it. The Tower of Jewels adjoining it suffered a less severe but more inglorious death at the hands of the destroyers. After the scintillating jewels had been plucked from their setting and sold to admirers, a stick of dynamite was touched off and the tower went the way of its numerous predecessors

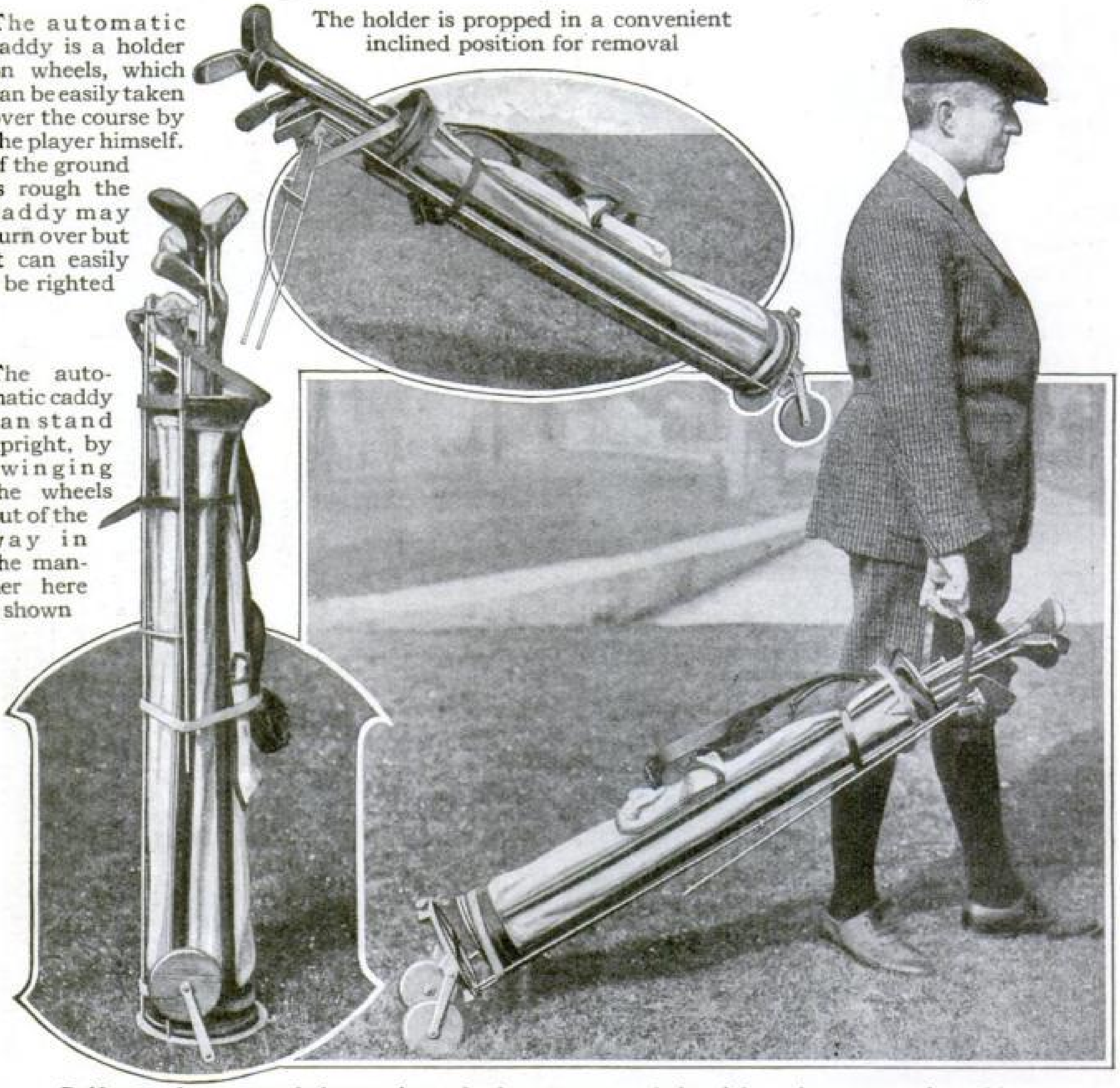
The Court of the Universe was perhaps the most auspicious exhibition of temporary art at the exposition. World-famed artists worked months planning it. Day laborers destroyed it in a few hours. The various historical groups forming the crowning features of the lofty court arches were not spared when the exposition had lived its day. The most delicately fashioned figures among the groups were pulled to earth and were followed, in turn, by the beautiful arches themselves

Reducing an Exposition to Dust



There are two stages in the temporary life of every exposition—the constructive and the destructive. In one, man builds with infinite care; in the other he destroys with reckless abandon. Here the Palace of Machinery is being reduced to dust

Doing Without the Caddy



The automatic caddy is a holder on wheels, which can be easily taken over the course by the player himself. If the ground is rough the caddy may turn over but it can easily be righted

The holder is propped in a convenient inclined position for removal

The automatic caddy can stand upright, by swinging the wheels out of the way in the manner here shown

Golfers no longer need the services of a boy to carry their sticks. An automatic caddy on wheels does all his work

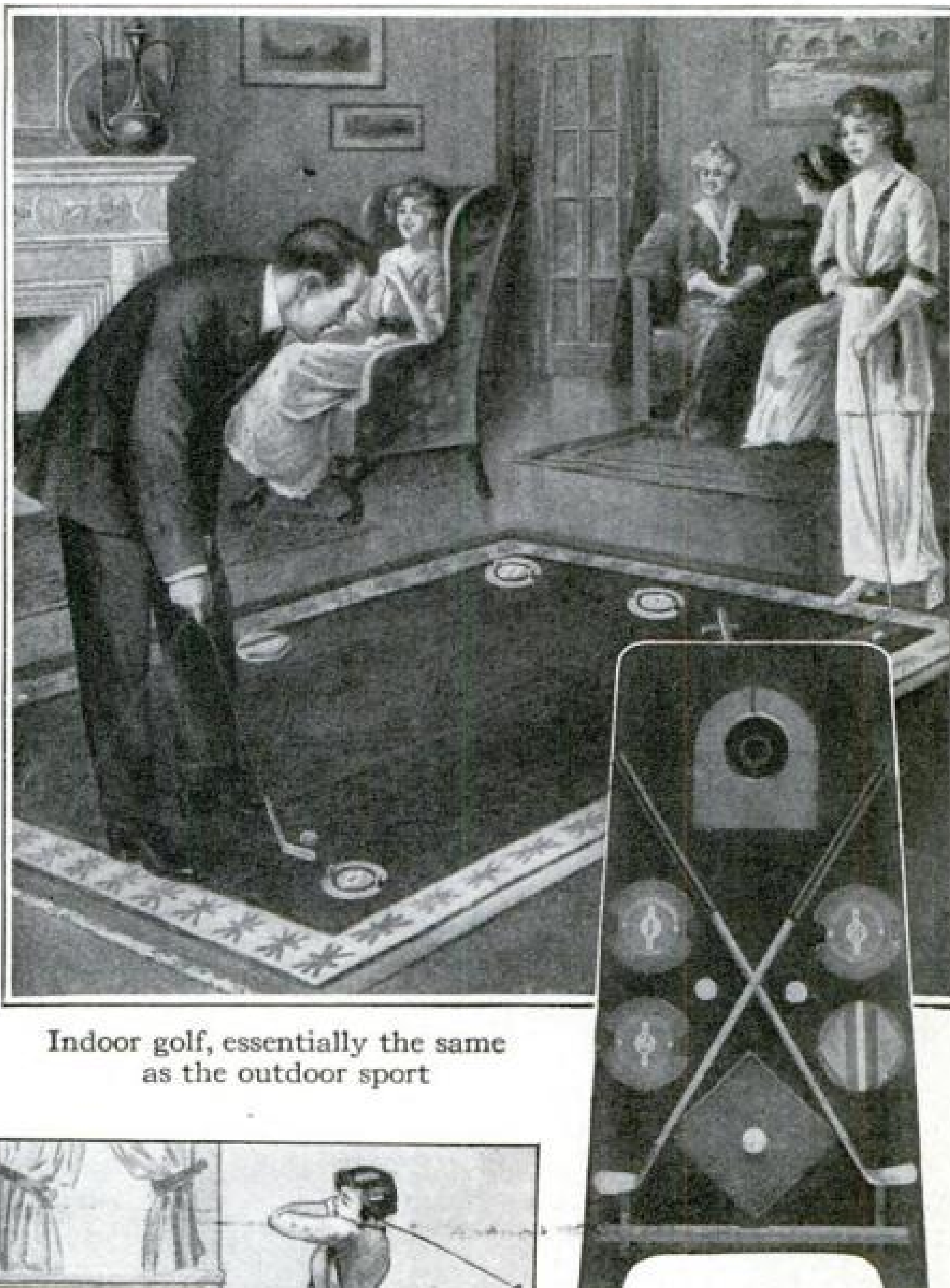
A NEW mechanical caddy for the golfer has been invented by John Deere Cady of Moline, Illinois. It is an ingenious, wheeled holder for golf-sticks, which the player can easily take over the golf course without the assistance of a caddy. Indeed, the caddy can be entirely forgotten, unless the player loses one of his golf balls, when he can call the caddy to his assistance and make him an offer to find the lost ball. As is usually the case, according to golfers, the caddy will readily agree to the bargain and then saunter off, find the ball, and forget to return with it.

However, the device illustrated herewith should make the player somewhat independent at least. It is made to hold the golf-clubs in a convenient inclined position for removal. The most efficient caddy could not improve on this particular feature. In wheeling the holder along, the player merely has to grasp a handle pivoted at the top and walk jauntily on. If the ground is a bit rough the automatic caddy may turn over a couple of times but it can be easily righted.

When the player has finished his game the automatic caddy can stand upright and thus take up a minimum of space.

Golfing at Home

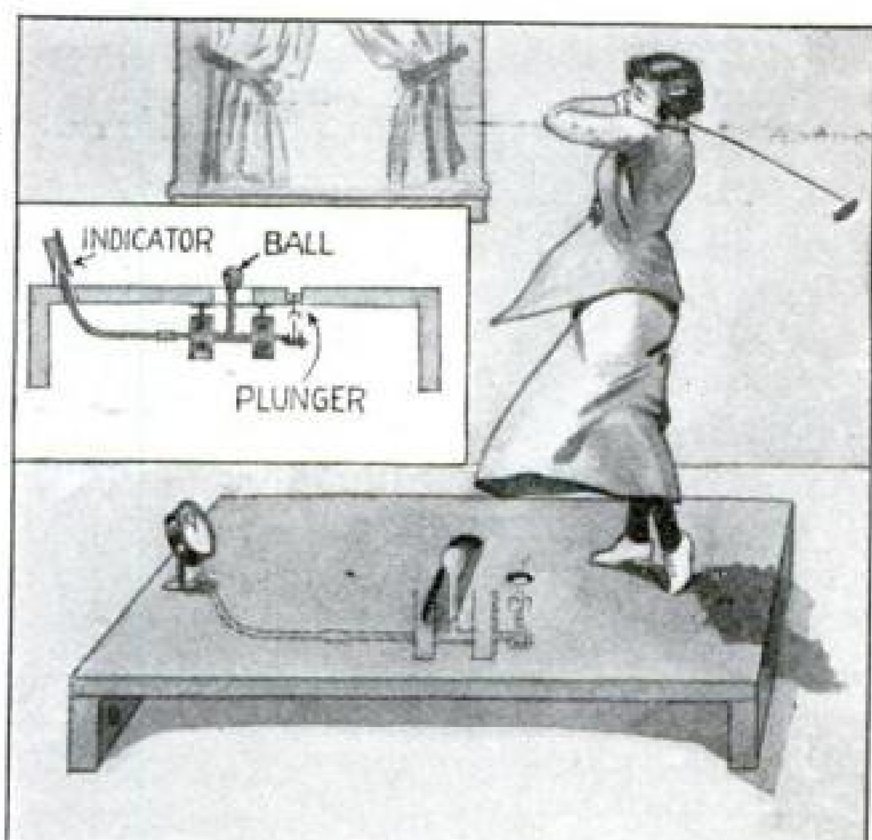
THE apparently leisurely game of golf doesn't consist merely in "knocking a pill around a ten-acre lot," as ex-President Roosevelt is credited with having described it. Furthermore, the game doesn't need to match well with special clothing, shoes, clubs, cocktails, professional instructors and similar adornments. It is now possible to bring it into the home and have the family play it without being decked out in sport shirts.



Indoor golf, essentially the same as the outdoor sport

Indeed, the indoor game is the next best thing to the outdoor game itself. It is said to parallel accurately all the characteristics of an outdoor course, and afford true putting practice. It can be played on any rug or carpet of good size.

The player starts off with a mashie shot from a felt tee over a bunker. After holing out, the next stroke is through a low and narrow hazard calling for perfect direction to the first disk.



Every drive is registered in yards by this machine for teaching beginners in golf

The disk is so constructed that a ball will enter from any angle with only a slight amount of resistance; but once in, it cannot roll out again. The three disks, hazard and hole are easily turned around, so as to face the ball. Should a ball be played against the outside walls of the hazard, it will be deflected sharply to one side but will not roll beyond the edge of the rug.

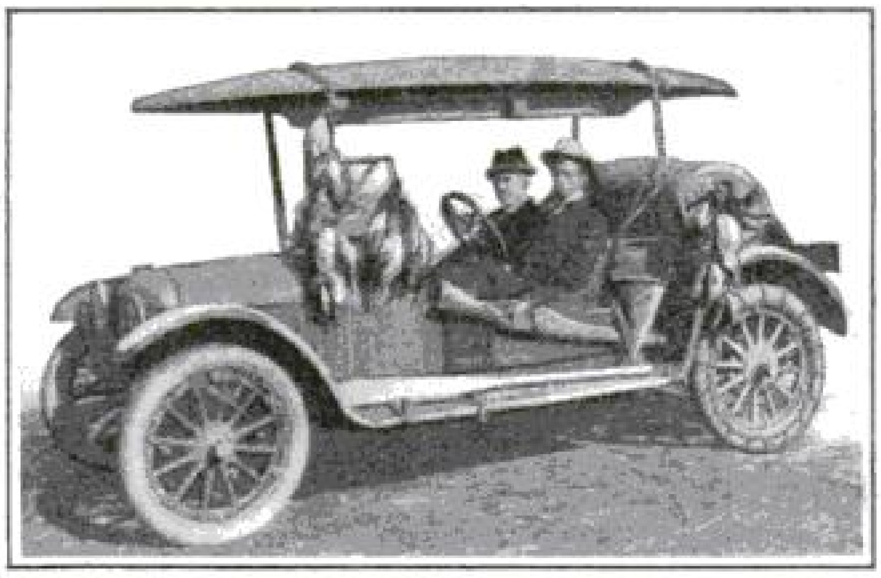
Devices for teaching special golf-strokes at home have been invented almost without number. One of the latest is a machine which has been invented to teach scientific driving.

The diagram explains the working of the golfer's "first aid." It is a ball mounted on a ball-bearing shaft. It has all the fascination of a roulette wheel and your drive is registered on the calibrated dial.

A plunger-spring set in the floor brings the ball to rest "all tee'd" and enables the player to drive off as frequently as he wishes.

A Duck-Boat as an Automobile Top

NOVEL camping outfits have, from time to time, been introduced, but it is doubtful if anything more daring and ingenious has been conceived than an automobile with a duck-boat for a top, the invention of G. W. Clark of Glendale, California. The boat not only takes the place of the regular top, but also serves as a sunshade. In a very few moments the car is made weatherproof simply by attaching waterproof sides to screws located around the outside of the cockpit. To reduce weight, the seat has been taken from the boat. At the proper time one of the spring-seats is taken from the car; it fits snugly within the boat. In transit the bars are tightly strapped within the boat, out of the way.



This boat can be carried to any duck pond which is accessible to an automobile; on the road it serves as a canopy

The boat is held in position above the car by four strong steel braces. The two forward braces, fastened to the sides of the car immediately in front of the windshield, extend upward for a distance of four feet, and between their upper ends a rubber-covered steel crosspiece is fastened, curved downward slightly to accommodate the oval top of the inverted boat. To hold the boat firmly down against this cross-piece, a heavy strap is run through openings at the tops of the uprights and over the boat, and drawn tightly against the upturned bottom. The rear braces, which are located just behind the seats, have been arranged in the same manner. Additional braces keep the boat from moving forward and backward.

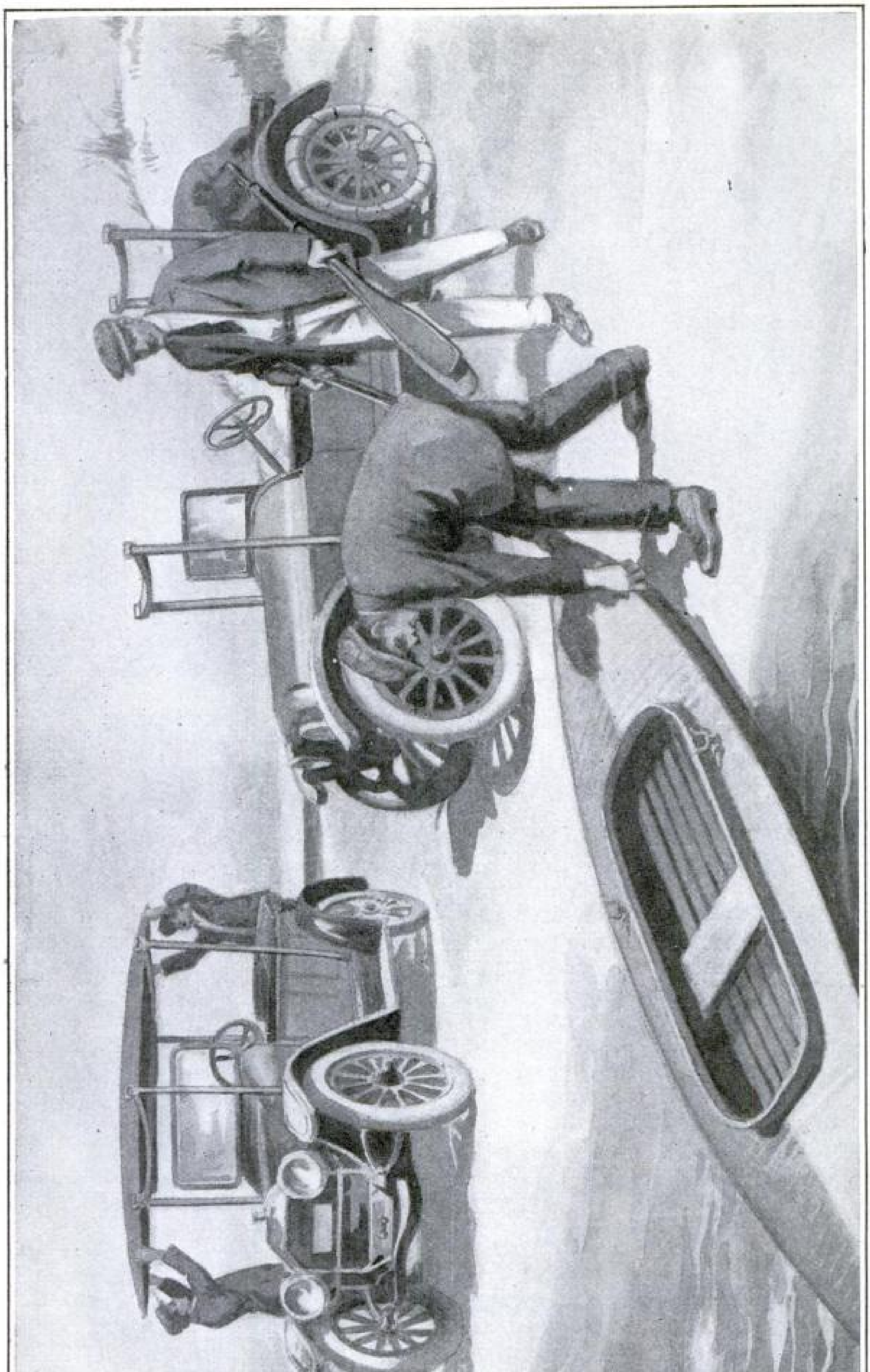
To convert this boat into a bed it is taken down and placed right side up on the ground. The two spring-cushions from the car are placed within the cockpit, their tops being about flush with the top of the cockpit-rail. Upon this foundation a bed is spread.

When the ducks alight out of the range of the "high boot" hunter, the owner of this car takes down his boat and goes after them. Often he takes his duck automobile to mountain lakes where ducks abound, unfamiliar with boats.

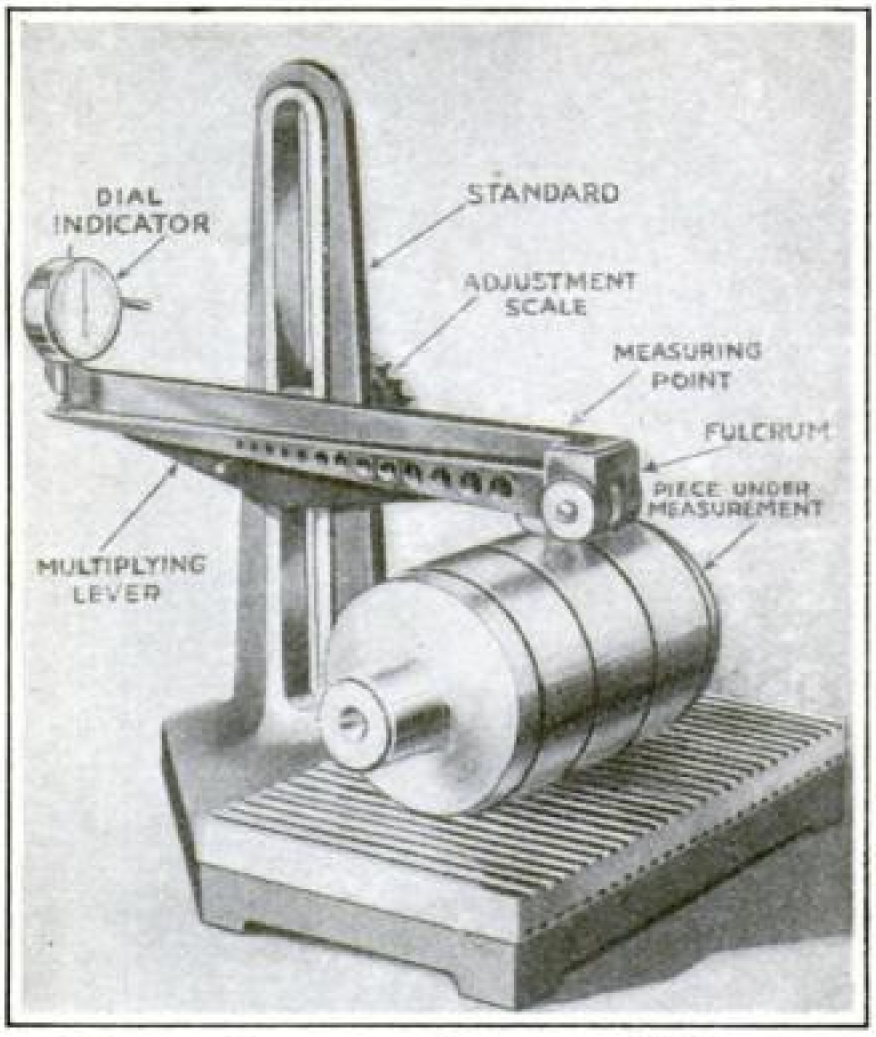
This duck-car carries everything necessary for a successful and enjoyable outing trip. Behind the seat is a large platform upon which is a spacious trunk. This is divided into sections for various kinds of food, hunting material, and the like. It can easily hold enough provisions for a month's trip of a party of two people. Upon the trunk is an "A" tent, within which the bedding is rolled, and behind the trunk is an extra tire. Water-bags and gun-holsters, are either strapped to the running-boards or hung to the sides of the car.

The boat may be set up at home as a "blind" for shooting geese, and when the hunting party reaches the particular point where they wish to wait for the geese no time need be lost in lowering the boat to the ground and placing it into position at once. Geese and ducks do not resent the appearance of an automobile provided it goes along slowly but surely. If it stops they get uneasy, of course.

With the boat rigged out as a blind at home, by using corn-stalks and weeds and sewing them to wire-strands and then attaching the whole to the boat-frame, the party of hunters can leave for the hunting field and when they spot a flock of geese flying within range they can lower the boat as the automobile chugs along slowly and drop it to the ground, falling in behind it. The chauffeur can continue driving the car and the hunters can then fire from behind the impromptu boat-blind without being discovered by the birds.



Four strong steel braces, connected by rubber-covered steel cross-pieces, act as supports for the duck-boat when it is used as an automobile top. The spring-seats of the automobile can be transferred to the boat for use in the water and as a bed



If a machine part is too small by one twentieth the width of a hair, this measuring scale can detect it

A Measuring Machine More Sensitive Than a Human Being

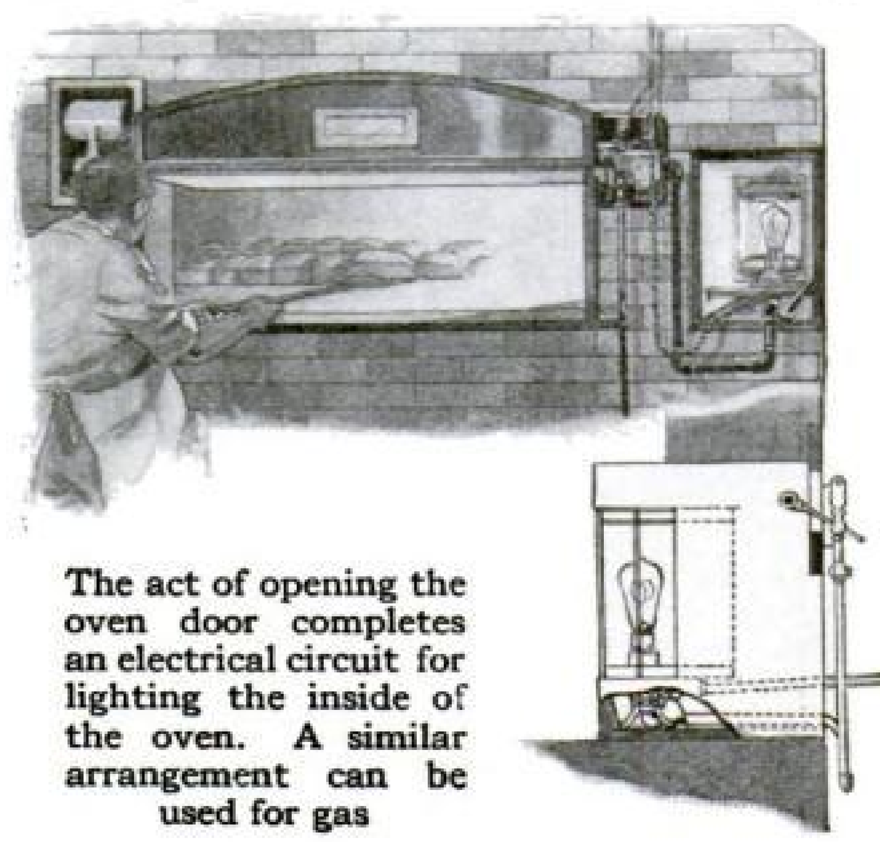
THE average person has little conception of the accuracy with which it is necessary to work on some classes of machinery. Ball-bearing parts, for instance, are produced in large quantities, yet in some cases the limit of error is placed at one tenth of one thousandth of an inch or about one twentieth the thickness of a human hair. Special measuring appliances are needed to make these fine measurements in a commercial way because hundreds of duplicate parts must be gaged per day. The human sense of touch is coarse in comparison.

The multiplying indicator illustrated is a very satisfactory device for measuring parts that must be accurately gaged without loss of time. The machine consists of a substantial base-plate with an accurately ground, hardened steel facing and an integral standard carrying a measuring appliance. The dial-indicator reads in thousandths of an inch, each graduation representing a one-thousandth inch movement of the indicator stem.

The work to be measured is placed under the measuring point on the multiplying lever. As this is very near the fulcrum, a relatively slight motion will be changed to one of ten times that magnitude at the dial-indicator. If the work is but one thousandth inch larger or smaller than the standard, the pointer of the indicator will move over ten graduations on the dial. An error of one tenth of a thousandth will move the pointer one graduation. The measuring arm may be moved up or down to accommodate work of varying diameter, and when gaging duplicate parts, it is set by a standard master-disk of the correct dimensions. Any deviation can be easily detected by a comparatively inexperienced operator.

Lighting the Inside of an Oven

A BAKER'S oven, illuminated on the inside, is a great advantage since otherwise the contents cannot be closely inspected, unless withdrawn from the oven. An arrangement, suitable for electric or gas lighting, is shown in the illustration. The door is hinged to the frame by means of pins. One pin is provided with a counterweight to facilitate the action of the door in opening and closing. The other pin has a crank-arm. On an extension on the door is mounted a knife-switch, with two short fingers to engage with the crank-arm. The opening of the door establishes an electrical connection with a lamp mounted in a casing near the door. If gas is used, the crank-arm engages with the shank of a valve which regulates the flow of gas to the burner in the casing.

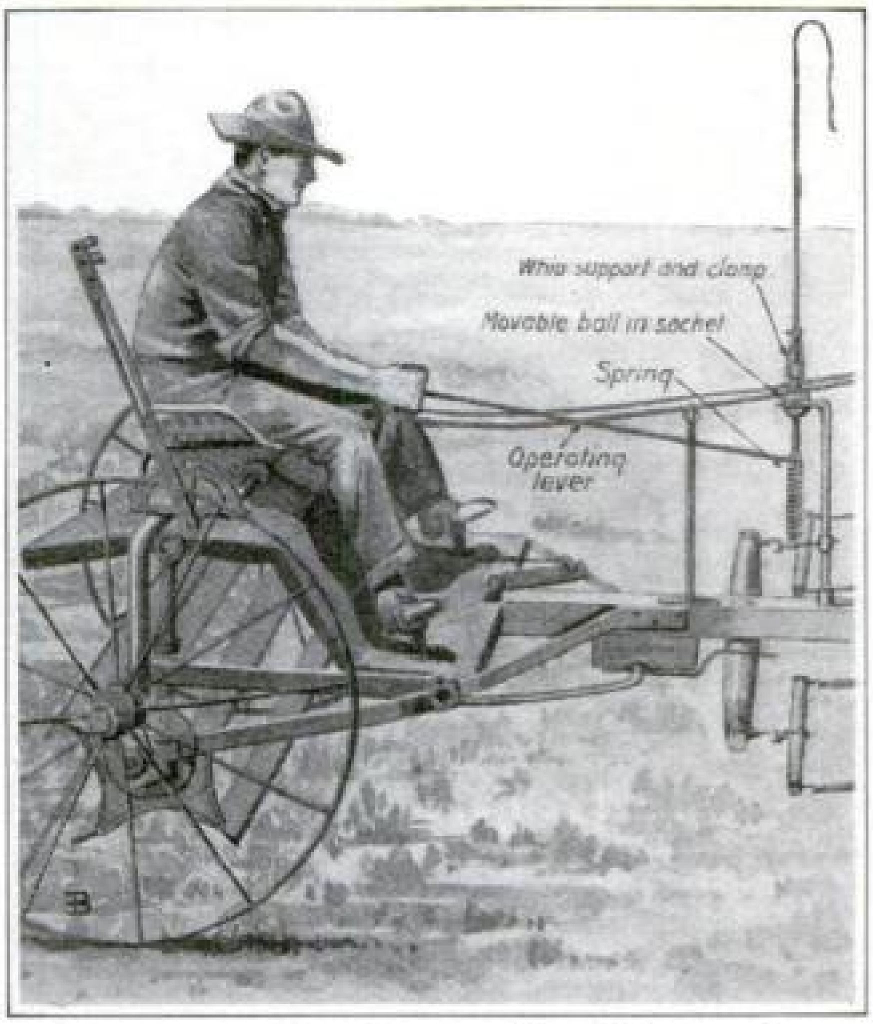


The act of opening the oven door completes an electrical circuit for lighting the inside of the oven. A similar arrangement can be used for gas

A Mechanical Whip

AN apparatus easily attachable to the tongue or thill of any horse-drawn vehicle enables the driver to wield a whip without touching it. He does not have to carry his whip, yet it is ready for use at all times. His hands are free when operating harvesters, dump-wagons, riding-plows, and this is a decided advantage.

The construction of this device is based on the spring and lever principle. An upright iron support is attached to the tongue or thill. The upper part is bent back toward the driver with the end expanded into a ring whose diameter is horizontal. Fitting in the ring is a ball through which passes a whip-support. This extends upward for the reception of the whip, and downward to connect with a stout spring.



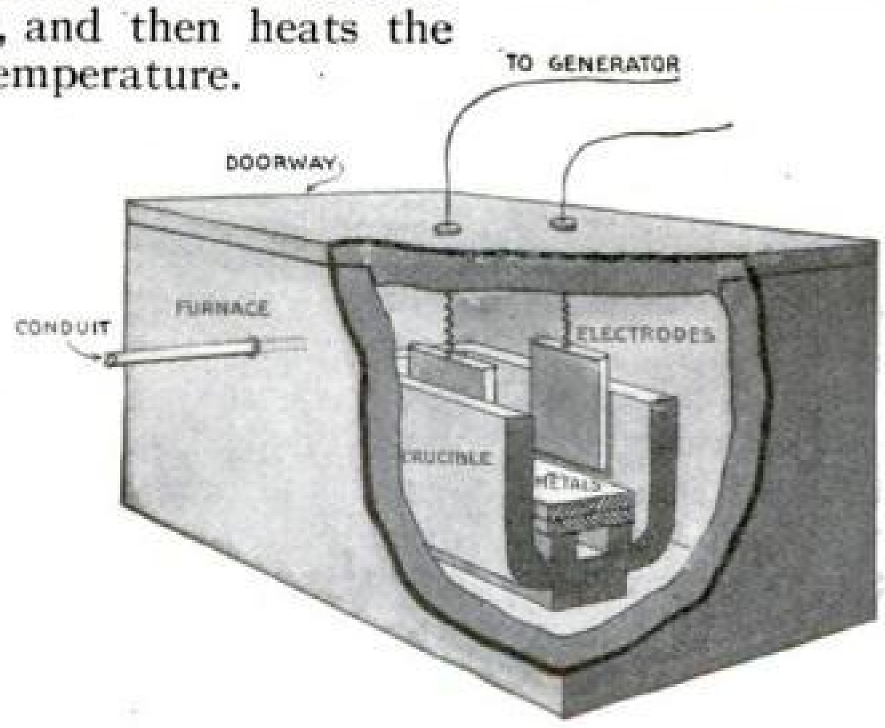
By means of a lever, this whip can be applied in any direction

A long rod is attached to the whip-support at its junction with the spring, and this extends backward to the driver's seat, terminating in a hand-grasp. This rod is suspended in its middle portion from an angular bracket attached to the body of the vehicle. This supports the rod and prevents the ball from dropping. The action of the ball and spring is such that the whip may be manipulated in any direction and when released returns to its original position. It is a more humane weapon than most whips.

Welding Soft Metal to Hard

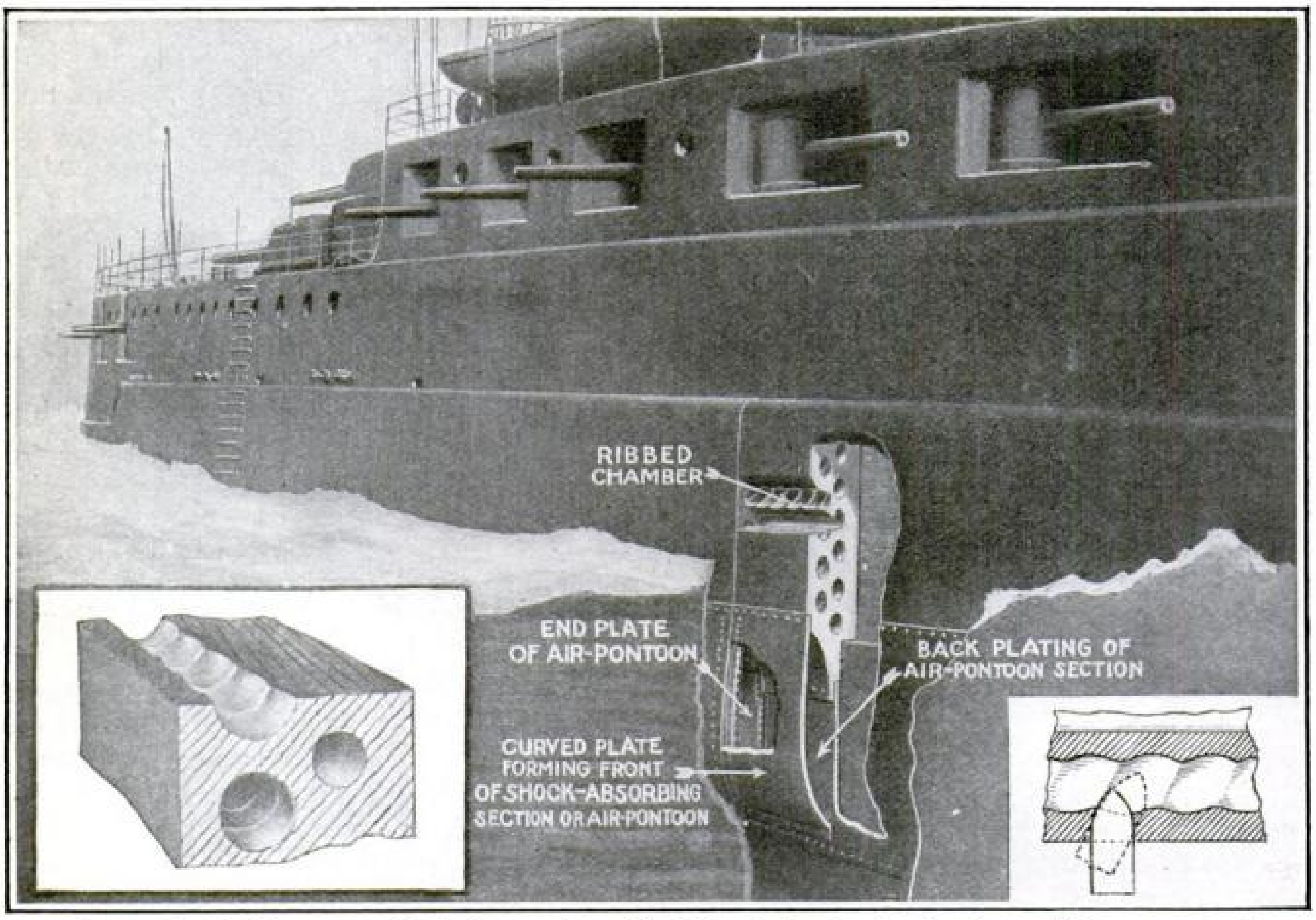
FOR welding copper or aluminum to iron or steel or for welding to any hard metal, such as iron, nickel, steel or the like, a comparatively soft metal such as copper, zinc, silver or gold, an apparatus has been devised which brings the surfaces of the two dissimilar metals into contact with each other in a vacuum or partial vacuum, and then heats the metals to a high temperature.

The apparatus comprises a container or furnace preferably made of refractory material with a metal jacket provided with a doorway which, when closed, makes the interior air-tight. A pipe or conduit enables the air to be exhausted by suction. After cleaning, the two dissimilar metals are placed in contact with each other within the crucible. The doorway is sealed, the air exhausted, the current turned on, and an arc is formed between the electrodes, which forms sufficient heat to bring the temperature of the two metals near the fusing point of the softer metal. When this occurs a weld or union of the surfaces is the result.



By producing a vacuum around two metals they can be quickly welded. The air in the metal furnace is exhausted and an arc formed between the two electrodes. The heat melts the metals and they intermingle readily. This welding can be effected between any soft metal and one which is hard

Protecting a Battleship with a Belt of Air



A new battleship armor is built on the principle of the shock-absorber. The corrugated chambers, backed by others of smooth-bore, first deflect the shell, and, when it explodes, the air takes up the shock and the expanding gases are carried off by the chambers, which are destroyed but save the hull itself from destruction

READ the accounts of the battles fought off Heligoland and the Falkland Islands, in which ships protected by heavy side armor were sunk by gun fire at ranges of five miles and the question must occur: What is the good of armor? If twelve and more inches of steel can be penetrated by the fifteen-inch guns of a British battle-cruiser at distances of miles it would seem as if victory in sea engagements is a matter of hitting power rather than of protection. That armor of some kind is necessary would follow from the fact that naval architects are very close students of naval history and that they promptly apply in the construction of fighting ships the lessons taught on the proving-grounds and in battle. That the heavy gun seems for the time being to have gained the ascendency over armor is proved by the fact that in battle-cruisers high speed and enormous striking power are considered more important than steel sides; for the armor belt of a battle-cruiser is only twelve inches—hardly sufficient protection against anything but projectiles of low caliber and low striking energy.

Inspired by these considerations, Louis Gathmann, whose experiments in hurling high explosives against armor on proving-grounds attracted much attention some sixteen years ago, has invented an entirely new system of armor protection which deserves consideration. His object is to obtain not only protection, but lightness; for the heavier the armor of a ship the fewer must her guns be or the weaker her engines on a given displacement.

In carrying out his ideas Mr. Gath-

mann would provide a ship with a chambered shell-resisting section and with a shock-absorbing section, the first above the second, as the accompanying illustration shows. The chambers of the first or shell-resisting section are really horizontal tubes, the front series of which are spirally ribbed. "Should a projectile penetrate the hard face of the armor," says Mr. Gathmann, "it would force its way through the line of least resistance, and thereby glance upward, downward or sideward as the case may be, turning or tilting the projectile, thereby destroying its penetrating power; such shells may fracture or explode, but without penetrating the armor."

A fifteen-inch shell carrying high explosive generates gases on exploding which exert tremendous pressure. That pressure must be absorbed, or else it may breach the ship below the armor belt. So, Mr. Gathmann attaches to the lower edge of his chambered belt a series of air chambers or pontoons, each independent of the other.

Study the illustration which accompanies this article and you will see that this shock-absorbing section consists of five walls: a downwardly-extending portion of the armor belt; a rear plate to which that downwardly-extending portion is bolted; a curved front plate, and two end plates to enclose the pontoon or chamber.

The pontoons seem flimsy, and in reality they are. But they are intended to be destroyed. The pressure of the gases from a huge shell will disrupt one, two, perhaps three shock-absorbing or pontoon sections, but the rest will remain intact. The air within the chamber will have a cushioning effect. Water will rush into the compartment, but the pantoons will still remain in place.

An Instrument for Plucking Flowers

A NEW German invention seeks to simplify the tedious and fatiguing labor of picking flowers and seeds. The instrument, already patented, which is here illustrated, consists of a sheet-metal tube combined with one-blade shears. The lower front part of the tube is formed as a seven-pronged fork and this fork is advanced towards the flower to be gathered from below it. The flower is caught by the prongs and is cut from the stem by a knife above the fork that works upon a light pressure on the handle of the shears. When separated from the stem the flower falls through the tube into the bag underneath.

Rapid gathering of flowers without injuring the stems can be accomplished with this instrument

The rapidity and ease of gathering reduces the expense. It is also claimed for this instrument that the plants are not damaged as in hand-picking, in which twigs and branches are easily injured and the entire plant is frequently torn out of the ground. Good service has also been done by the device in gathering seeds. The difficulty here in hand-picking is that the dry pods are often crushed and the seed scattered, while by the new method the seedpods fall uninjured into the bag and no seeds are lost. It is also hoped that the instrument, which is the invention of an apothecary of Colditz named Meyer, may prove serviceable in hop-picking.

The flower-cutting instrument has been found particularly effective in cropping dandelions when the plants are young and the flowers only a few inches high. For this kind of work the device is operated along the ground like grass-cutting shears, and as fast as the metal receptacle fills it is tipped and the severed flowers fall into the bag.

A badly impacted wisdom-tooth. Radiograph shows the need of cutting away portion of jaw

Light area shows extent of jaw-bone affected by pyorrhea, commonly called Rigg's disease

The instrument has passed through the tooth into an abscess which was located by the radiograph

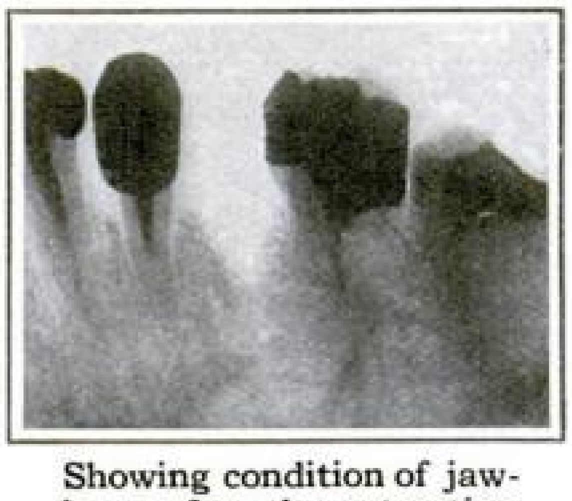
What X-Rays Can Do for Your Teeth

THE purchasing agent of a large corporation took a night train from Buffalo for Pittsburgh. It was cold and the next morning his face was fairly alive with pain. He concluded that neuralgia had singled him out as a victim. Consultation with a physician resulted in about the same opinion. And every time he got cold his face twitched with pain. In the course of time this man visited his dentist. The dentist had just installed an X-Ray outfit. Merely as an experiment a radiograph was made of the man's jaw. The tiny film when developed showed that a tooth was improperly filled. A small portion of the root canal at the extreme end of the tooth had not been cleaned out. Whenever the purchasing agent's temperature rose from a cold or other ailment, his blood pressure, of course, rose also. And when the blood pressure rose, the tiny blood vessels which nourished the tooth swelled and the swelling pressed against the sensitive tooth. The result was a pain of a twitching sort which almost anybody at first might call neuralgia.

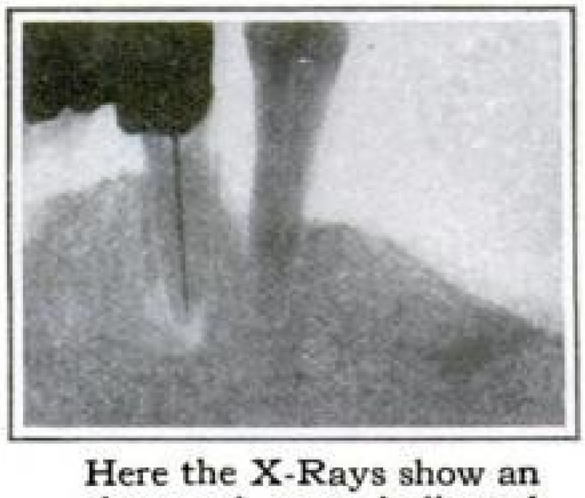
There is absolutely no pain connected with the taking of a radiograph in dentistry. The operator simply places a small piece of film in the patient's mouth which the latter holds in position with his thumb. The patient then closes his eyes and holds his breath for a few seconds and it is all over so far as he is concerned. The dentist can develop his film in a very few minutes. He is able to draw his conclusions while the film is still wet because the signs which mean so much to him are as plain on a negative as they would be on a finished print.

The X-Ray outfit can be used to detect any number of defects in a filling. It can also be used as a check on another dentist's work. Furthermore, it enables the dentist himself to give the patient information of an absolutely accurate character on the condition of the teeth. For instance, a radiograph would show the dentist and the patient whether it was necessary or not to pull the tooth instead of treating it, with the ultimate intention of prolonging its existence.

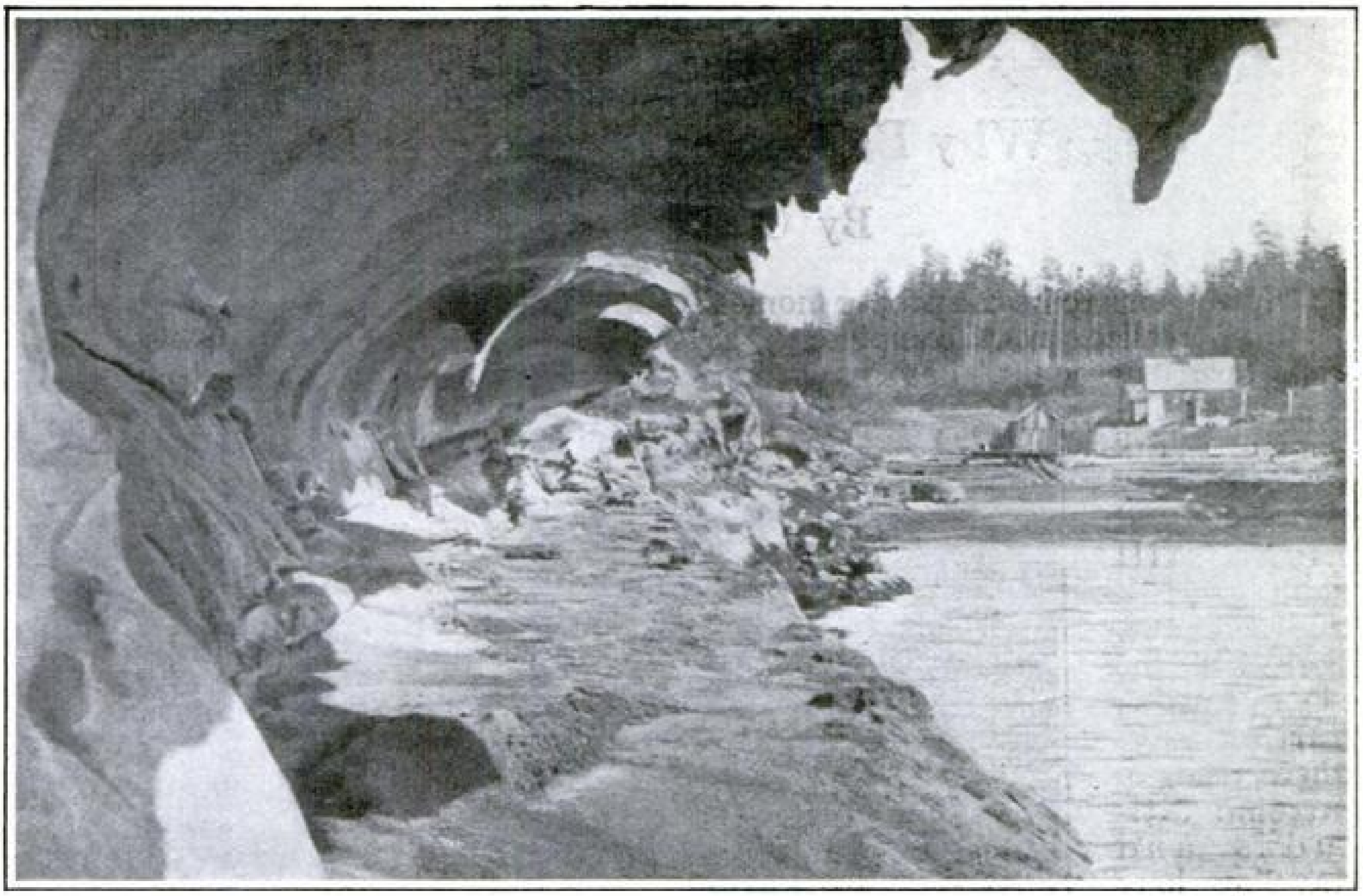
Radiograph which was taken to locate an eye-tooth which had not grown out due to crowding



Showing condition of jaw-bone after the extraction of an abscessed root. Dark areas are gold fillings



Here the X-Rays show an abscessed area indicated by the light spot at the end of the tooth



A natural shelter worn away by the persistent grinding action of pebbles and sand thrown against the rocks by the splashing of waves

How Sea Caves Are Made

CONSTANT warfare is being waged between water and soil. The photograph shows a rocky recess in a friable sandstone which has been excavated by the scour of currents and beating of waves along an arm of the sea on the east side of Vancouver Island. The bed which the waves have cut away is obviously of softer stone than the underlying one, while the overlying layer is hard and resistant and sufficiently massive to overhang for some distance. The view is an excellent illustration of shore erosion. It is not exactly correct, however, to speak of waves or running water as scouring and grinding agents. Water alone has little power to erode stone but it is a potent grinder.

A Lamb with Two Coats of Wool

THE little lamb in the picture has two coats of wool, but only one of them is his own. A ewe is disinclined to adopt some one else's children, even if her own do die. To deceive her into the belief that her own lamb is still living, its pelt has been used as a coat for another lamb. She recognizes the pelt by the smell, and believes it to be her lamb. If the adopted lamb is a twin or if its mother is dead, this arrangement is greatly to its advantage, but once the mother discovers that she has been made the victim or the "goat," she leaves the adopted young to its own destiny and refuses thereafter to have anything to do with it, even though its pelt be changed again.

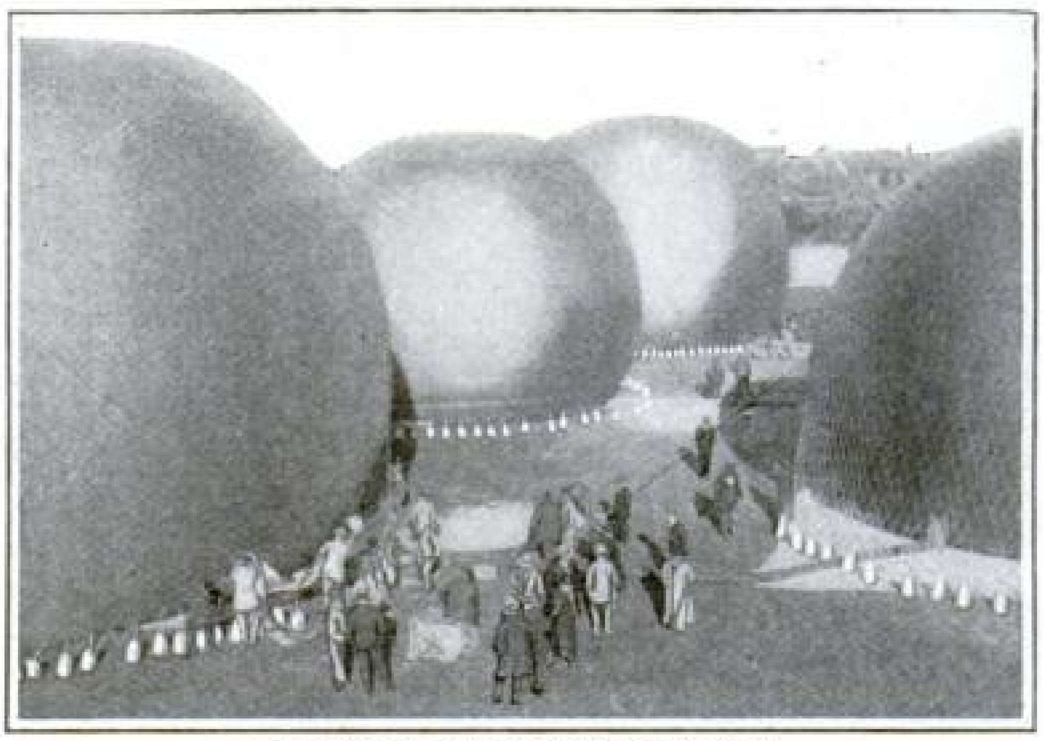
It is a wise ewe that knows her own lamb

Yachting in the Air

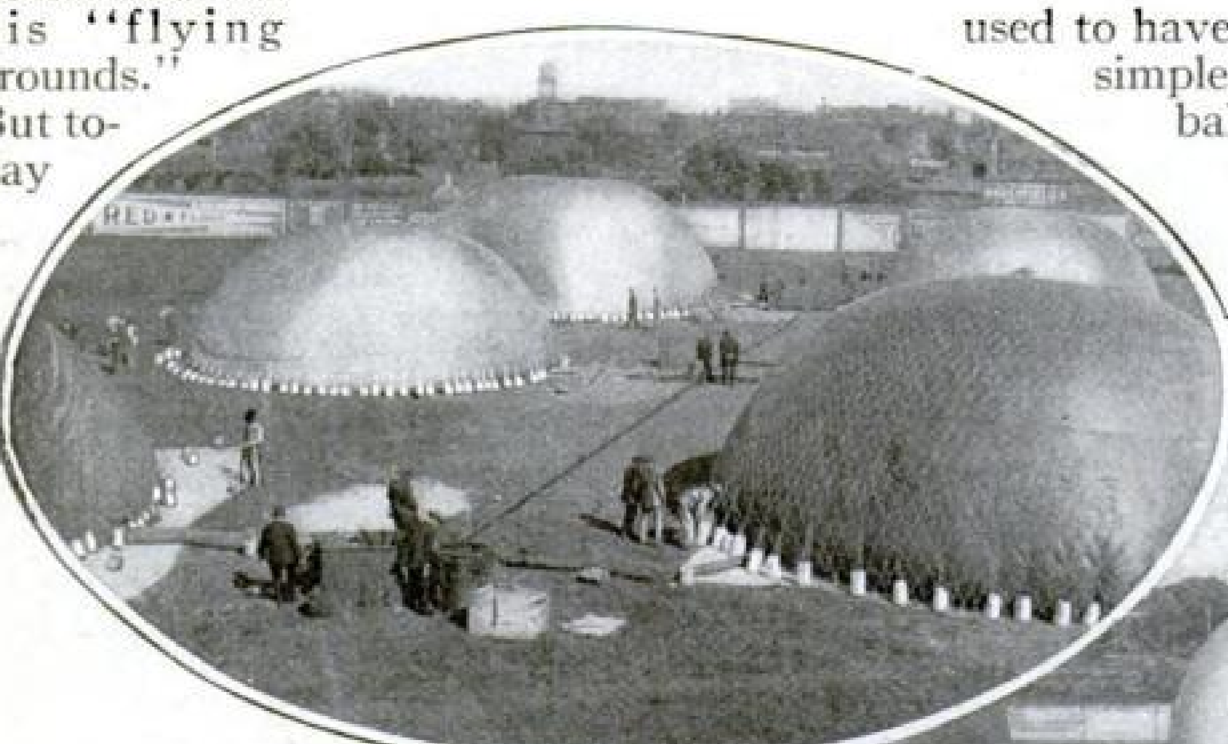
Why Ballooning Will Never Die

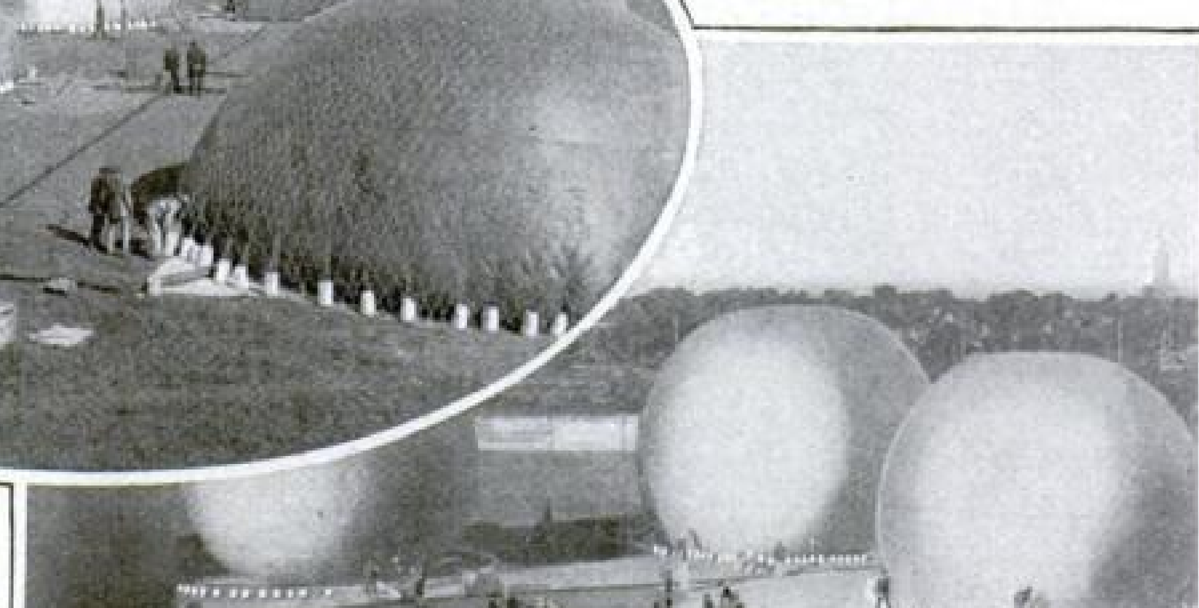
By Carl Dienstbach

THIS seems to be the proper moment to realize how completely the term "aeronaut" has changed its century-old meaning. Until recently only the balloonist might still claim to be a true aeronaut, fearless of the elements, starting anywhere, rising to extreme altitudes and traveling long and far, while the average aviator was confined to his "flying grounds." But to-day there is not one among the army of war aviators whose exploits are not as daring as those of any balloonist. Notwithstanding this transformation, however, the old-fashioned gas-bag maintains its popularity. In a past age people referred to it as a thing which "didn't know where it was going, but was on its way." Today, when highways are swarming with cheapened motor-cycles and automobiles, the privilege of choosing one's destination has largely lost the fascination it used to have. Yet it remains for the simple, old-time, wind-driven balloon to give us the lure of sailing into limitless space and of enjoying a view of ever-changing scenery far grander than that afforded by the highest mountain peak. Indeed, the

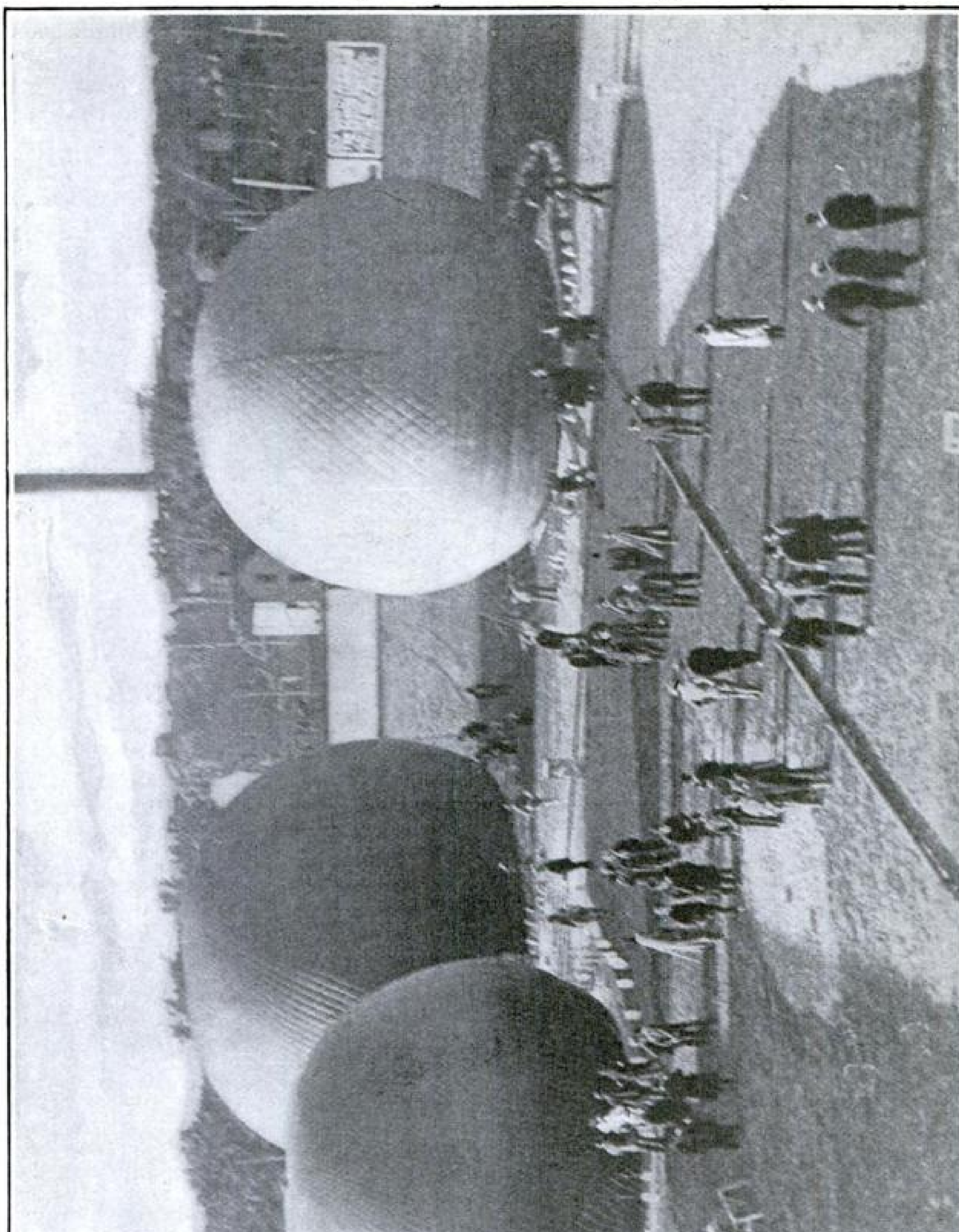


Gas bags when fully inflated





Above, the first stage of inflation when the sand bags have to be closely watched to prevent tearing of the envelope. At right, the bags resemble huge puff-balls. At this stage all that is necessary to tip them over is a strong wind



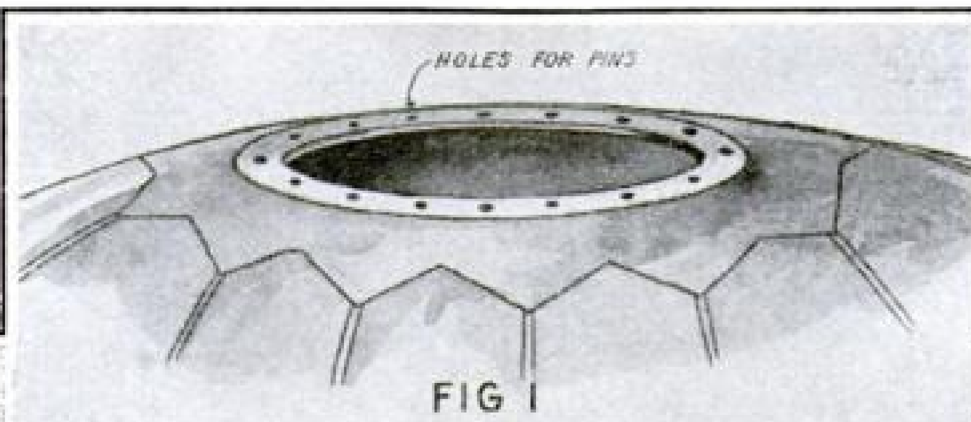
The preliminaries of a balloon ascension. Ready to pull the bags "off their feet." The next step is to attach the basket

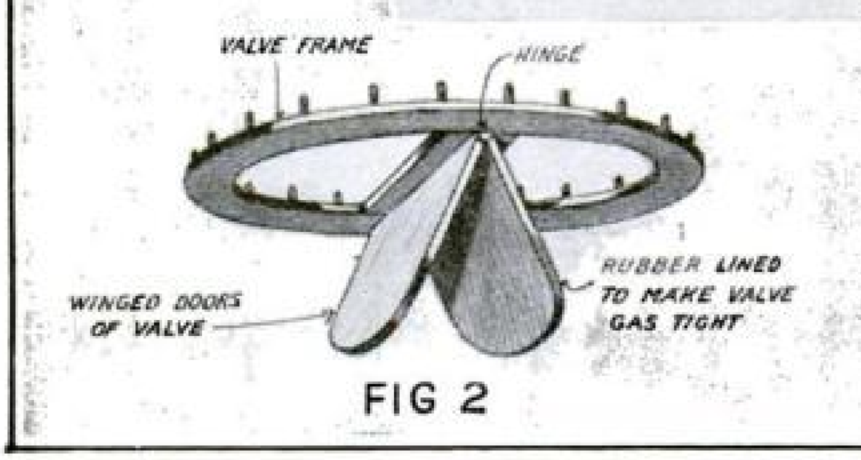
extreme simplicity and cheapness of the balloon will keep it popular for many days to come.

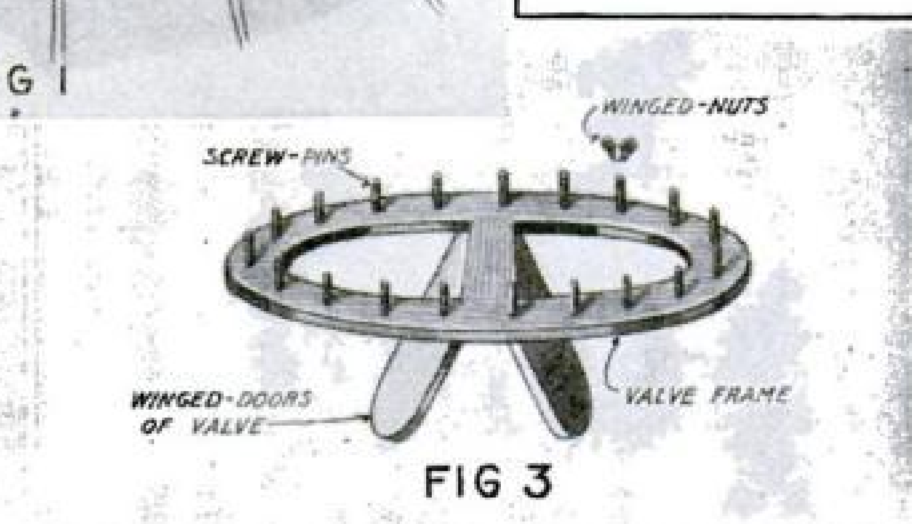
How Balloons Are Made

It is a comparatively simple matter to make a balloon. All one needs is a large quantity of thin cottoncloth, some linseed oil, a light, wide-mesh "fish-netting," a small amount of medium-gage rope and a big willow basket. The valve on top of the gas-bag is essentially only a small, close-fitting circular wooden door which any experienced cabinet-maker could construct. Other accessories are of equal simplicity.

If it were not for its prohibitive size and the cost of the material a balloon could easily be made by a handy amateur. Where there is natural gas light enough for inflating, as in Kansas, a balloon ascension can be carried out in a short time. The



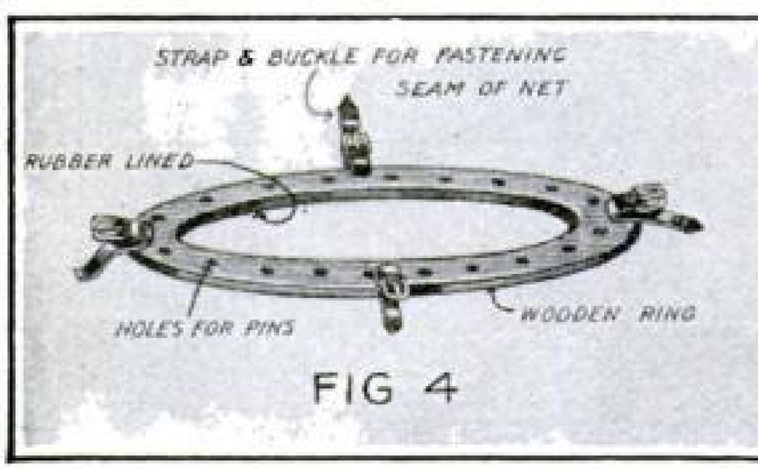




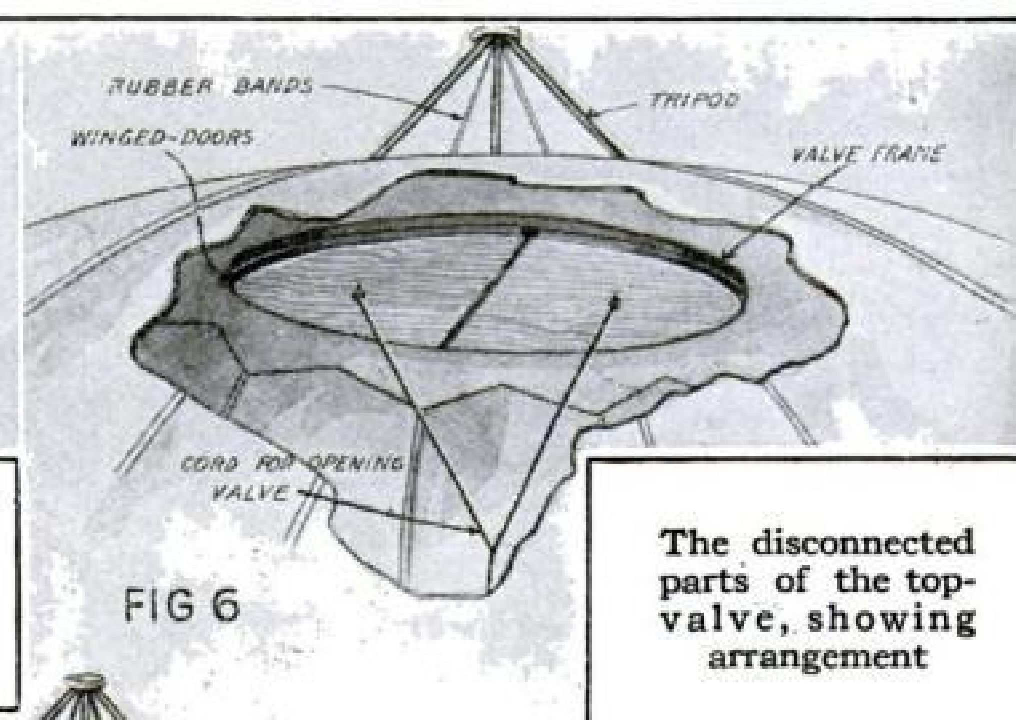
The "wings" are rubber-lined and gas-tight

The circular ring with holes arranged for pins

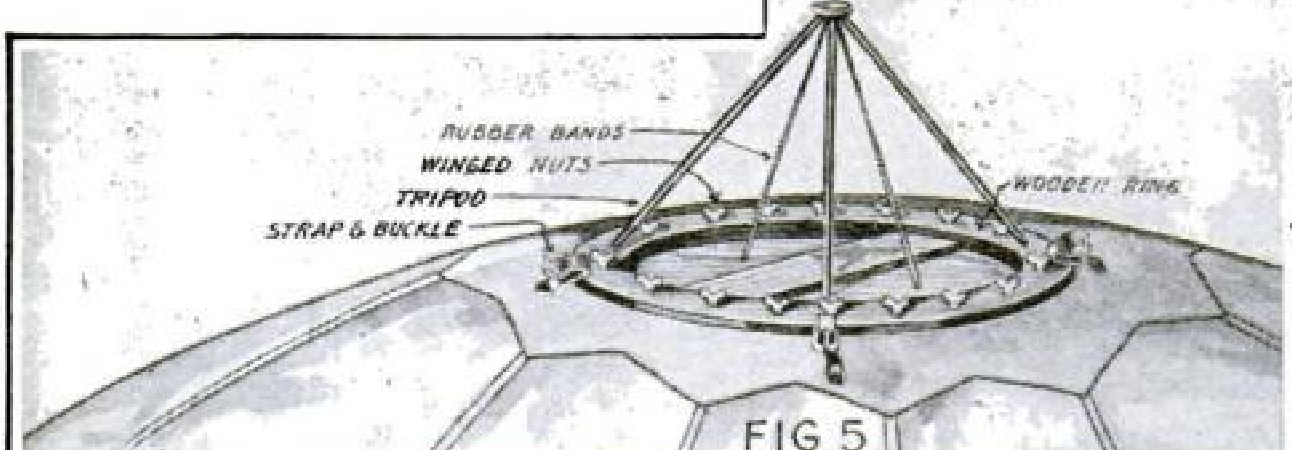
Two hanging "wings" form the circular wooden door



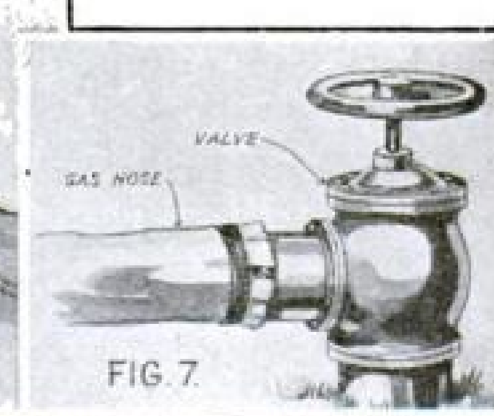
The seam is buckled to the margin by a series of short straps which hold it securely in position



The disconnected parts of the top-valve, showing arrangement



The top-valve equipment closed in its correct position



How the hose is fastened to the gas-main

requirements are a moderately large, level space, a gas-main several inches in diameter, a cartload of sand, two dozen sandbags (eight by sixteen inches, with four one-foot cords collected in a hook around their open end), and plenty of strong men who aren't afraid to hold on to the bag.

The outer part of the empty rolled gas-bag is the short hose, called appendix, at the balloon's lower end. A short cylinder of equal diameter is slipped into its end, and a longer hose of balloon cloth is stripped over both and securely tied around them. The other end of the hose is similarly tied to the outlet of the gas-main, whereupon the bag is unrolled and spread around the appendix as the center. The seam of the round opening on top of the bag is tightly screwed into the circumference of the valve. The seam of the similar opening in the net is buckled to the same margin by a circle of short straps. The net is spread in the same manner, and a wide circle of sandbags, previously filled, is built around the spread bag and net and hooked into the meshes.

How the Balloon is Inflated

Once the gas is turned on it dilates the hose with a roaring sound, rushing into the balloon and raising the center of the spread. You have the impression that the gas which finds it so hard to puff out the cloth could never lift a man, but you do not realize the physical fact that the buoyancy is increasing continually with the additional space occupied by gas. Soon the meshes of the net begin to pull the bag hooks, and since the circle occupied by the spread cloth narrows with the increasing inflation the bags must be moved in gradually and evenly.

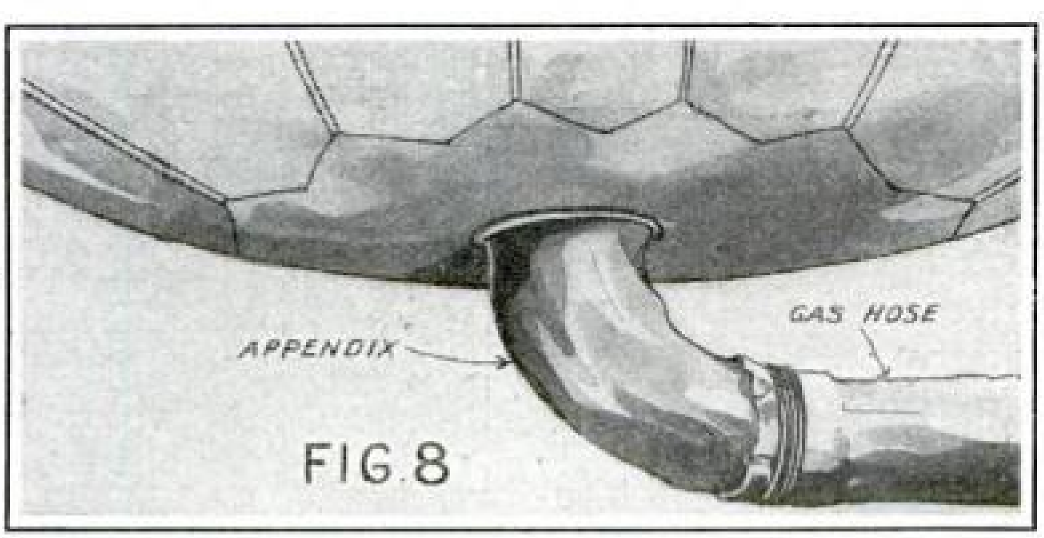
It is an interesting sight to see the balloon grow like a mountain out of a circle of cloth. Even after the buoyancy increases the sandbags lash it firmly, for their total weight is far greater than the maximum lift, and their individual weight overcomes the fraction of lift exerted by the mesh to which each is hooked. As the bags narrow in on the net they crowd together. Finally they reach the lowest meshes and are lifted from the ground by the attendants. Then the fully inflated balloon, now permitted to rise sufficiently to untie the hose from the appendix, is led to the basket nearby.

The ends of the ropes into which the net issues are hooked by loops to the "collecting ring" above the basket, and the hooks are now released from the meshes and put over the ropes. By sliding them slowly in toward the basket the balloon is allowed to rise to its normal position above the basket by finally hooking clusters of bags around the lower ends of the stout basket-ropes. After a few details have been attended to, such as tying the appendix with a knot, which can be jerked open while ascending, and arranging valve, rip-cords, ballast-bags and instruments, the passengers climb in.

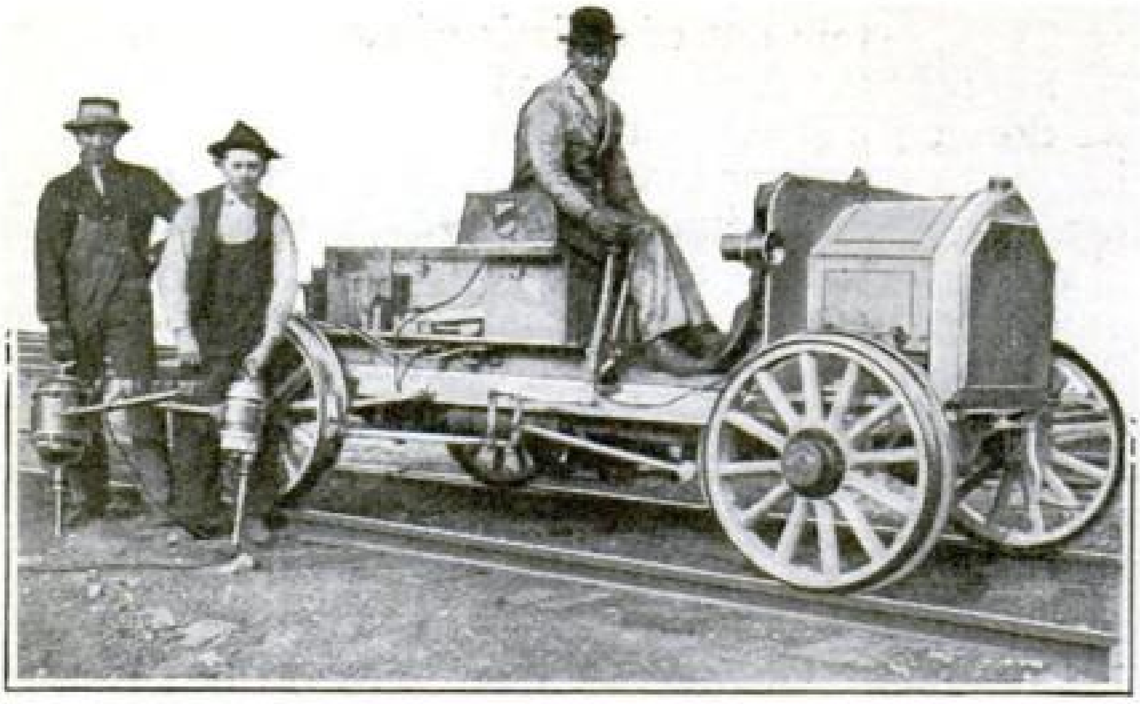
The Start of an Ascension

The wind soon pulls the basket "off its feet" and there is considerable bumping and scraping, during which it is a convenient thing for those inside to have an "upper berth." Following this comes the ticklish process of tentatively taking off sandbags until the lift is supposedly equal to the load and of letting the raised basket go for a moment to see whether it will fall or rise. When the final "let go" is given the excitement begins.

During the first moments of rising there is that queer sensation of riding in an endless elevator or Ferris-wheel. Soon this is forgotten in a world of silence.



An air-tight attachment must be made between the gas hose and the appendix



Driving spikes in railroad ties is accomplished with socket-wrenches run by motor

Driving Railway Spikes with a Motor-Car

THE latest thing in spike-driving apparatus for railroad use consists of an ordinary motor-truck mounted on railway car wheels. Attached to the engine-shaft is a generator which operates five motor tools for fastening the rail to the ties with wooden screws. Three of the tools are attached to wood-boring bits and two to socket-wrenches for screwing down the spikes. All five tools are operated at the same time.

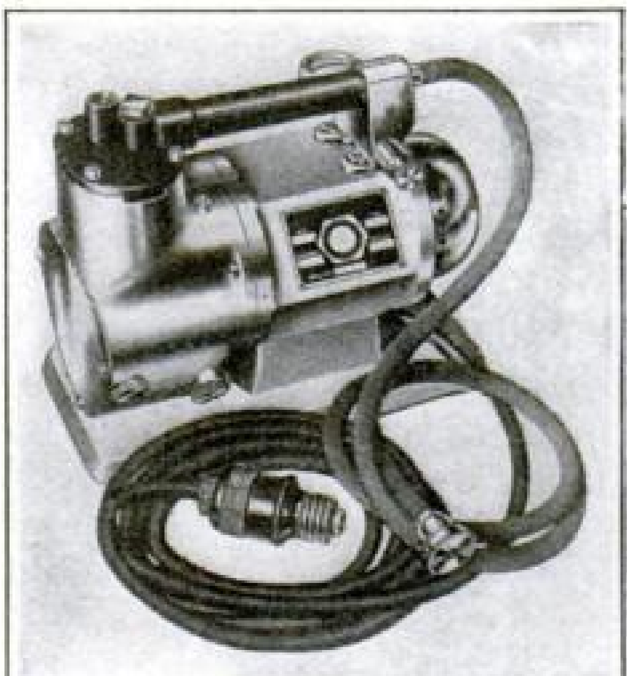
The car has a capacity for about five hundred and fifty spikes an hour and one thousand feet of cable are provided so that the crew of five men, three with the wood-boring motors and two with the screwing-machines, may work on two thousand feet of track without moving the car from its original position. Should a train come along, the car can be shifted to one side by means of a portable turntable quickly operated.

Portable Electric Tire-Inflator

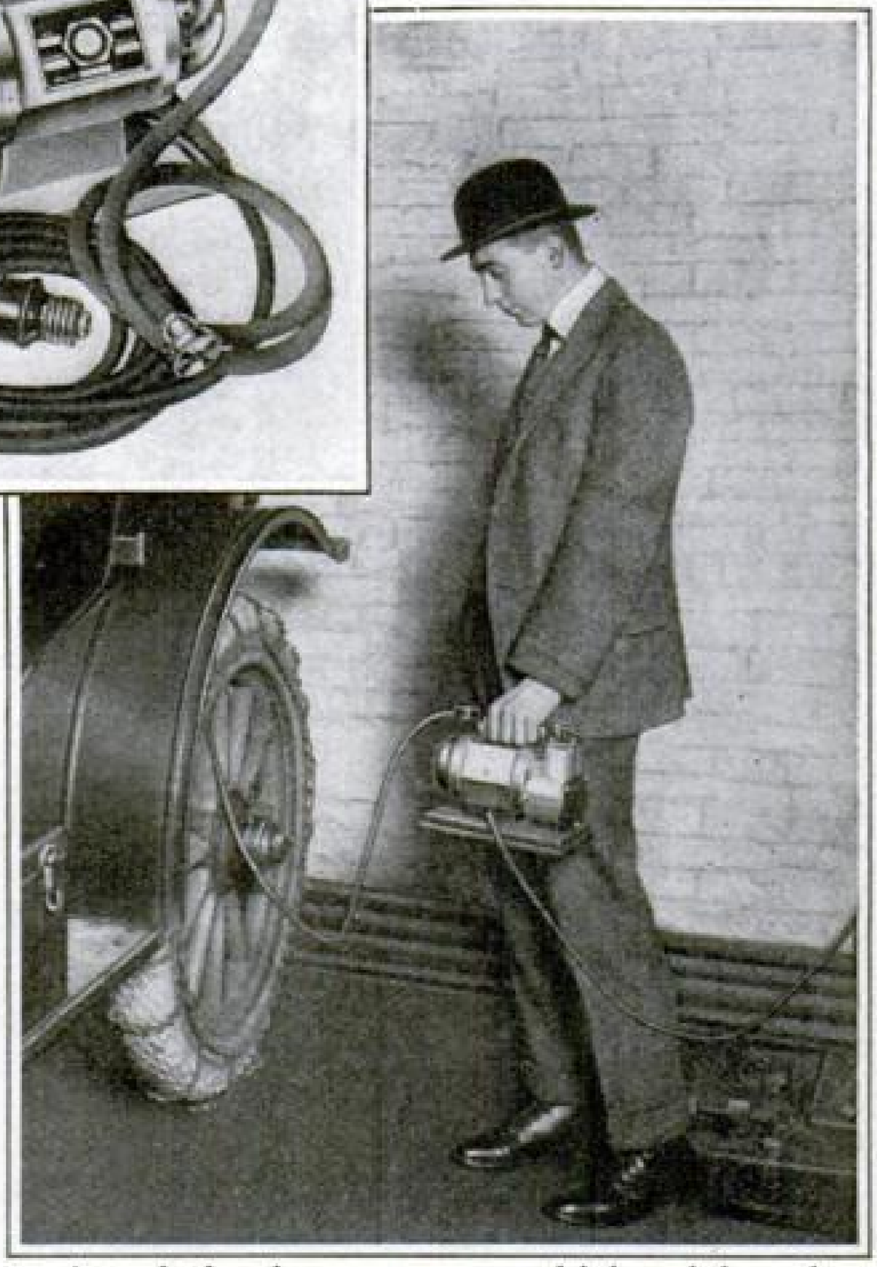
AUTOMOBILE tire manufacturers always impress on their customers the necessity of inflating tires to the proper pressure. If this precaution is neglected, the tire walls deflect more than they should, and the plies of which the tire carcass is composed tend to separate. This produces a weakening of the shoe and greatly diminishes the life of the tire; a blow-out is inevitable under these conditions.

There is no excuse for this neglect if the motorist is provided with the compact air-compressor outfit shown in accompanying photograph. In the device an electric motor and pump are combined in such small compass as to be readily handled. The device weighs but thirteen pounds and can be plugged into any light-socket where the potential is one hundred and ten volts, the almost universal lighting current. The current may be either alternating or direct.

This small outfit furnishes only cool, clean air. It will pump up to one hundred pounds per square inch pressure, which is sufficient for ordinary use.

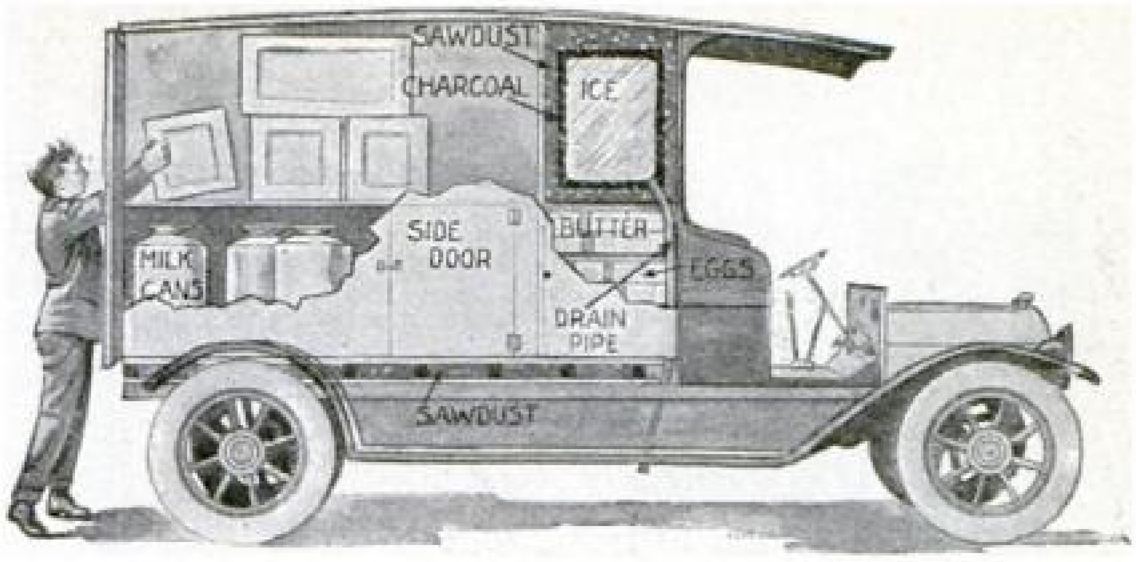


Sufficient hose is provided to make quick connections with any light-socket at hand



Attach the air-compressor, which weighs only thirteen pounds, to an ordinary light-socket and inflate your tires in a few minutes

Keeping Things Cold in the Automobile Refrigerator



At last we have a refrigerator on wheels, for delivering dairy products

USED by the owners of a large farm in Newport, Minn., to deliver milk, butter and kindred dairy products within a radius of twenty-five miles, the one thousand-five-hundred-pound truck shown in the accompanying picture is in reality a refrigerator on wheels. It is equipped with a double-sheathed body, filled with sawdust between the inner and outer skins to prevent radiation.

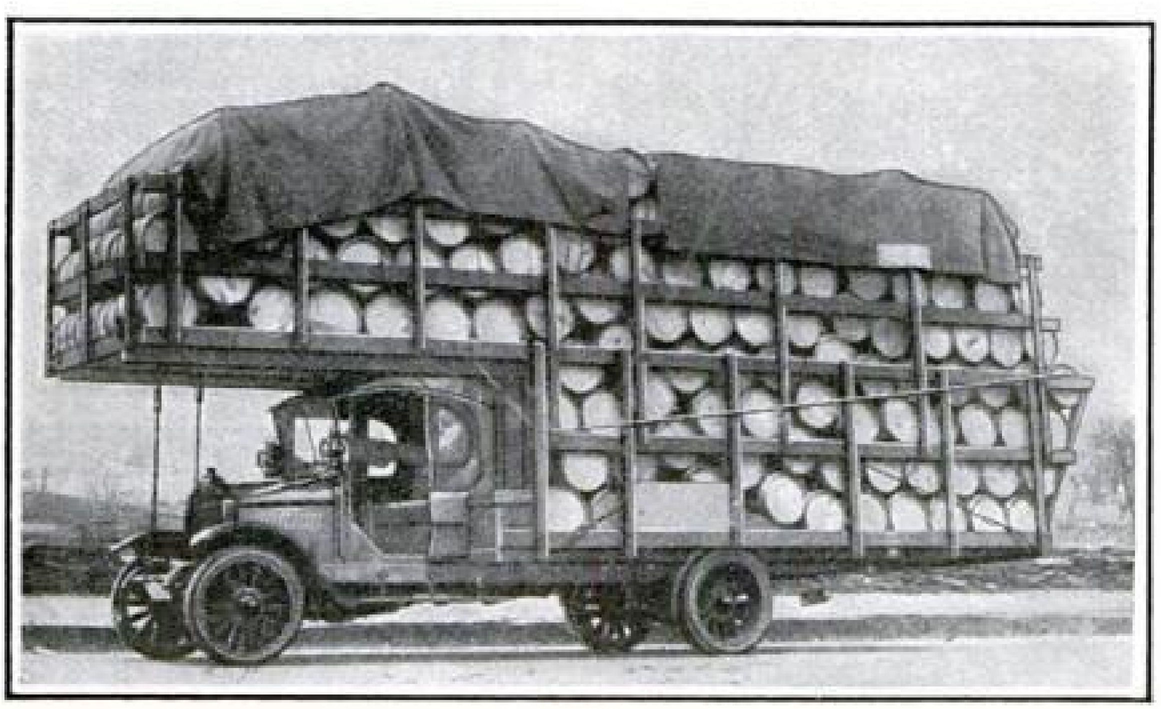
The interior is kept cool by means of a conventional ice-box placed directly under the roof at the front end, which is large enough to hold three hundred pounds of ice. The box is zinc-lined and is surrounded on all sides by a layer of charcoal. It is drained by means of a pipe extending down through the double floor to within a foot of the ground. Directly beneath the ice-box are three shelves crosswise of the body for carrying butter, bottled milk, pot-cheese, etc. Ten-gallon cans of milk are carried at the rear.

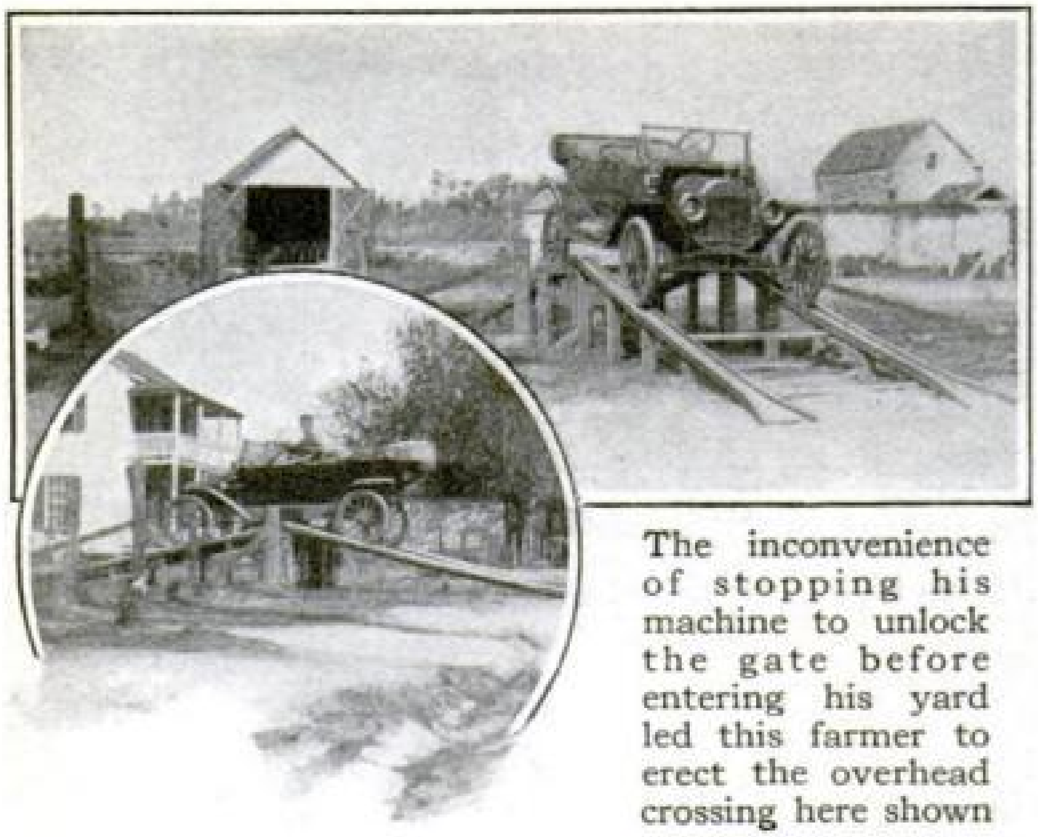
The large cans of milk or the goods carried on the shelves can be removed easily and quickly without opening the rear doors, this being accomplished through the two side doors, one on either side, shown directly behind the shelves. The doors are zinc-lined and when shut are air-tight.—J. HUSSON.

A Record Motor-Truck Load of Barrels

CARRYING a part of its big load above and in front of the driver's cab, the motor-truck pictured is equipped with a special rack-body capable of holding three hundred and eighty-five barrels. This is one hundred and thirty-five more than can be loaded into an ordinary railroad freight car. Some idea of the big load may be gathered from the fact that the extreme fore and aft length is about twenty-eight feet and the height above the ground, fifteen feet.

The vehicle, a three and one-half ton truck, is owned and operated by a manufacturer of barrels in Rock, near Middleboro, Mass. Most of the company's product is used by the cranberry growers in Plymouth county and down Cape Cod way. The growers now get their barrels directly from Middleboro by the motor-truck and in much less time than when shipped by freight, due to the elimination of railroad delays and the added haul from the plant to the railway at one end and from the latter to the cranberry fields at the other. In addition, loading at the sending end and unloading at the receiving station are avoided by the direct-to-the-door delivery of the truck, which makes this means of transportation not only quicker but also cheaper than rail. Only empty barrels are carried.


More barrels can be carried on this truck than in the largest freight-car



The inconvenience of stopping his machine to unlock the gate before entering his yard led this farmer to erect the overhead crossing here shown

How One Ford Got Up in the World

FOR nine months a Florida farmer opened and closed his gate leading to his garage every time he took out his Ford for a spin. Then he built a runway which put the gate to shame. With four pieces of eighteen-foot lumber two by four feet, eight pieces of one foot by three feet, and some short pieces two by four feet to form the supports, he had his runway constructed in short order at a cost of a few dollars.

Despite the fact that he has only the use of his right hand he steers his Ford on the runway with perfect ease. In addition to this he doesn't worry about the gate any more; and as for the pigs and cows that formerly played havoc with his garage furnishings, they belong to the troubled past.

The runway, as he constructed it, is strong enough to bear the combined weight of the automobile and its capacity load of five passengers. On wet, slippery days sand is sprinkled on the runway board to keep the machine from skidding. The side rims keep it on the track.

A "Shoo-Fly" For a Candy Kitchen

TO KEEP the door of a candy store open and to have no obstruction such as a screen door in the way of those entering, gives the flies full freedom to the sweetened goods. One shop keeper devised a very simple and attractive means of keeping the little pests from the goods on the shelves. The store was on the corner and only two walls were open for shelving.

At the top end of each section two flanged wheels were fixed to turn in a horizontal plane and a ribbon band was run as a belt between each pair of these wheels.

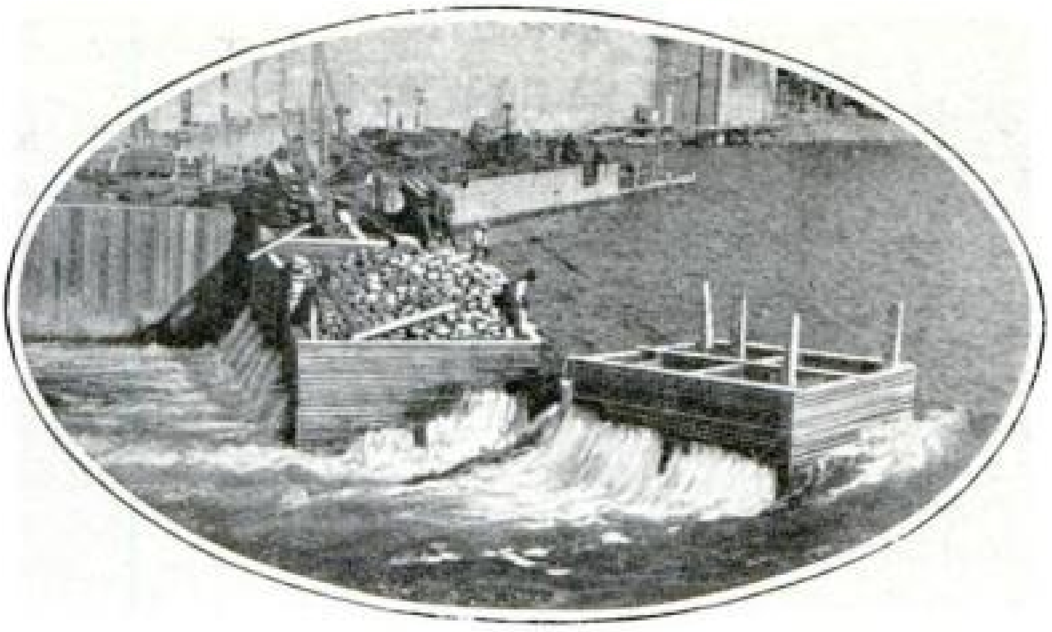
These were connected with a small electric motor to turn at a moderate speed. The tape used for the belt made a ready means for attaching numerous ribbons in different colors so that they hung like streamers from the top of the shelves to the floor.

As the band traveled around the wheels these streamers were carried in a slanting position, sloping back at the bottom from the direction of travel. As the ones on the rear side were going in an opposite direction it produced a latticed effect and the moving of the many ribbons kept the pests away. It produced a very attractive arrangement and many a passerby stopped to take a look at the moving colors.

The "Shoo-Fly" has also been used with great success to protect exposed fruit and vegetable stands, and has even been used for soda fountains.

These colored streamers fluttering past the shelves of candy effectually prevent the invasion of flies

A Ticklish Moment



If a cable should snap, the crib would be dashed to pieces on the rocks below the falls

THE work of building coffer-dams, or temporary dams, is often as ticklish and difficult as the larger and supposedly more important finished piece of construction which is impossible without the dams as a foundation.

The picture illustrates the placing of a section of the crib-work of a coffer-dam. Observe that the water is in almost flood state, because the natural channel of the river has been so much restricted by the already completed part of the work.

The cribs are built on dry land to very accurate measurements. When all is ready, each one is launched in its order. The methods of control, after launching, vary. In this case five steel wire cables of ⅝-in. diameter rigidly connected with five winches, located at points on the river banks, were used to control the course of the cribs as they were placed. When a new section is brought in line with the already existing work, it is held fast there by the cables and winches until the rock, piled at the end of the older part of the dam, is thrown into the spaces in the crib and the new section is thus "weighted into place." Then the cables and all other lashings are removed and the next section treated in like manner.

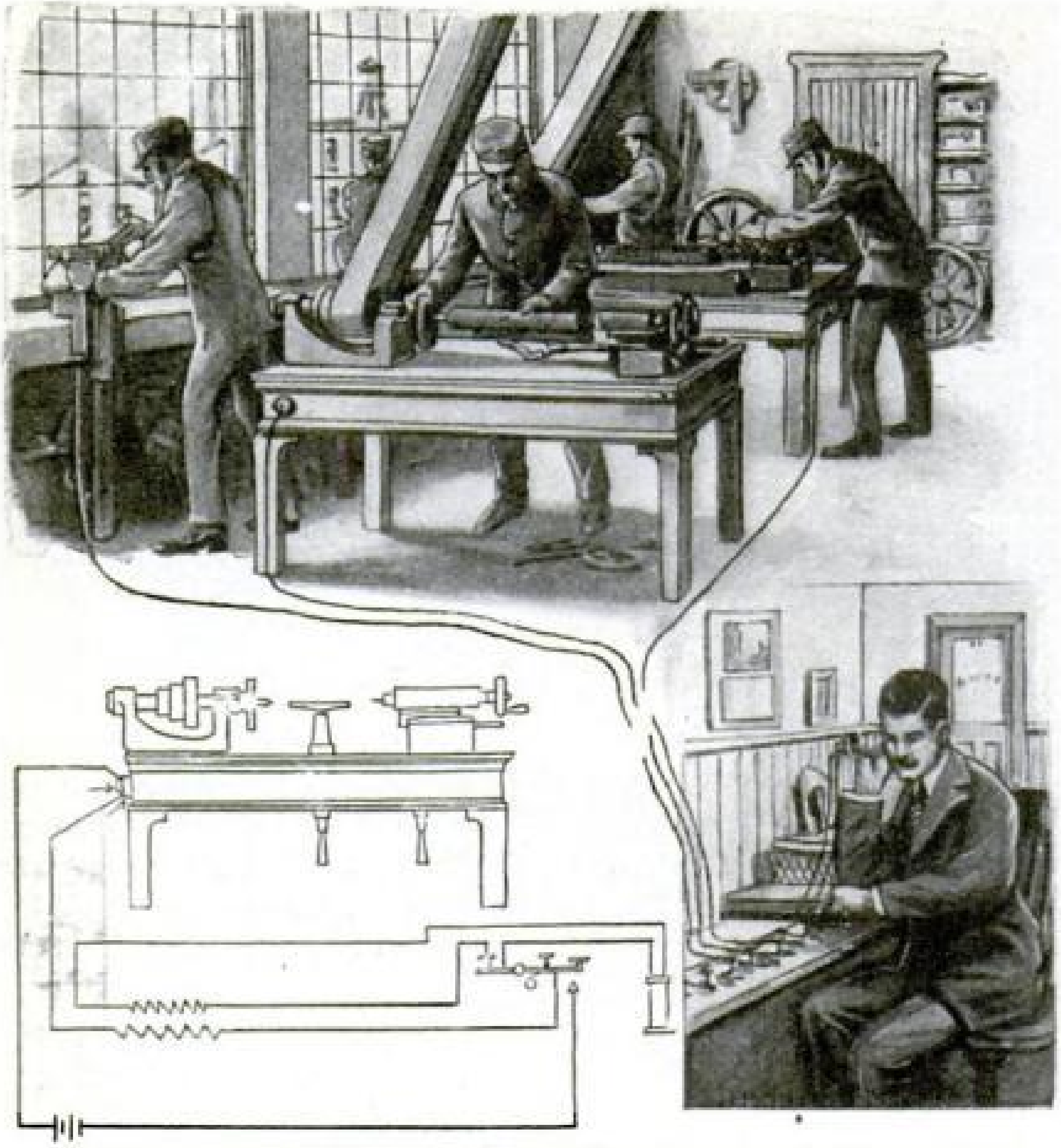
Something of the extent of the forces that have to be met with, due to the immense water pressure, may be gathered from the fact that during the placing of one of these cribs, one cable parted and the strain thus thrown upon the remaining four proved successively too much and they each in turn gave way. The crib meantime sailed gaily down stream, over the rocks and bumps of the falls below.

Where coffer-dams are thrown across deep channels of treacherous waters the work is fraught with the greatest danger, necessitating the most careful system of operations.

To ascertain the time, simply pull the watch down out of its case. The spring will withdraw it when released

A Protecting Holder for an Open-Faced Watch

WE illustrate an original idea in a watch-holder for wearing upon the person, especially for ladies' use, in which the watch is invisible and is pulled down by a suitable pendant so as to allow the face to be seen. The illustration shows the holder as seen from the back, with the watch partly drawn down and out of the holder against the top spring. A crescent-shaped piece receives the watch when drawn up. The watch may be of special shaped as here shown, or a flat disk can be used to serve as a watch-carrier, with an ordinary watch fitted into it by clamps. In this case the disk works with the spring and the pendant, allowing any watch of proper size to be fitted into it and carried with safety.



Strict accountability is enforced by the use of this machine

Hearing Your Men at Work

THE manager of a machine shop or factory can know how much work is being done at benches by mechanics or by power-driven machines or tools by means of microphones or telephone transmitters connected with the working apparatus. By becoming familiar with the vibrations of the different machines he can tell at any given moment just how fast Pat is working the lathe, or how industriously Mike is operating the milling machine on one of his blue Mondays. In addition to this he can tell at a simple turn of the switch if the machines are running at normal speed and smoothly and properly, as they should.

Interchangeable Pressing and Steaming Device for Tailors

A RECENTLY patented ironing-board for pressing and steaming garments is composed of a receptacle having a flange 11 around its open top. A hoop 13 presses upward against the gaskets 12 and downward against the short arms of several eccentric levers 14. This is shown in Fig. 2. Numerous recesses 16 in the sides of the receptacle allow for the movement of the levers.

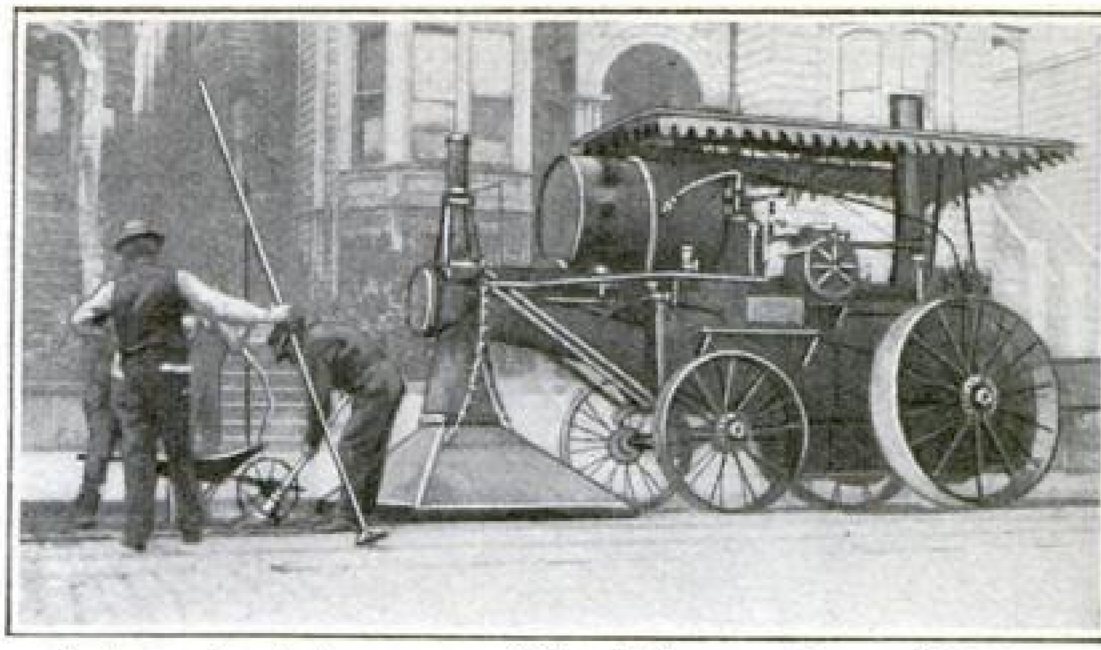
Two layers of fabric, the upper one air-tight and the lower one porous, are stretched over the top of the receptacle and secured under the flange by means of the hoop and gaskets. Within the receptacle is a longitudinally-placed conduit 19 having numerous openings. At one end steam may be admitted, and at the other end, air.

When pressing, air is admitted and its flow controlled so that a slightly rounded surface is obtained. The main advantage lies in the fact that shiny seams are avoided.

When steaming garments, the upper air-tight fabric should be removed. Steam can then be admitted instead of air. The porous under layer allows the steam to pass through and the rounded surface affords very close contact for the garment, insuring a thorough steaming.

Shiny seams cannot result because the pressure is evenly distributed

"Ironing Out" Earthquake Wrinkles in San Francisco



Intense heat from an oil-blast furnace is applied to breaks in the pavement so that it can be leveled

AT the time of the earthquake many pavements of San Francisco "wrinkled" under the strain. Traffic since has increased the uneven surface. By the use of the machine shown in the picture, old pavements are made like new. A traction-engine is fitted with an oil-blast furnace and a hood by which a section of pavement from the curb to the car track is softened until it can be leveled by raking. Each section is then successively smoothed and rolled in the regulation way.

The most disastrous effects of the earthquake occurred in parts of the city where the ground consisted of "made" land, especially in a large area adjoining the Bay, which consisted originally of mud flats and overflowed lands built up with layers of sand, waste, and the like. Under the shaking of the earthquake, this soft ground tended to flow along the slopes, causing pavements and street-car tracks to break up or buckle. Here and there the ground was rolled into waves three or four feet high. Where the texture of the soil was very loose, the ground surface was lowered. What occurred in the latter case was just what happens when a measure into which grain or loose sand has been poured is shaken in order to make it settle down. The shaking causes the particles to come closer together and the mass occupies less space. The rainfall had been much above the normal for three months before the earthquake, and the soil was therefore more soft and plastic than usual.

Many observers in the region visited by this memorable earthquake have furnished graphic descriptions of the visible undulations of the ground that formed a feature of it, especially in soft alluvial soils. The waves were from one to three feet in height, and their length, according to one description, was about sixty feet from crest to crest. Trees and telegraph-poles were seen to rise and fall as the billows of earth swept by.

How Automobiles Innocently Break Windows

WHEN a heavy automobile runs over pebbles no larger than a pea, a pebble may be caught just right by the edge of the wheel and shot with such a high velocity that a broken window is the result. One firm in New York has had three windows broken, all in the same frame. The layout at this particular place is as indicated in the drawing.

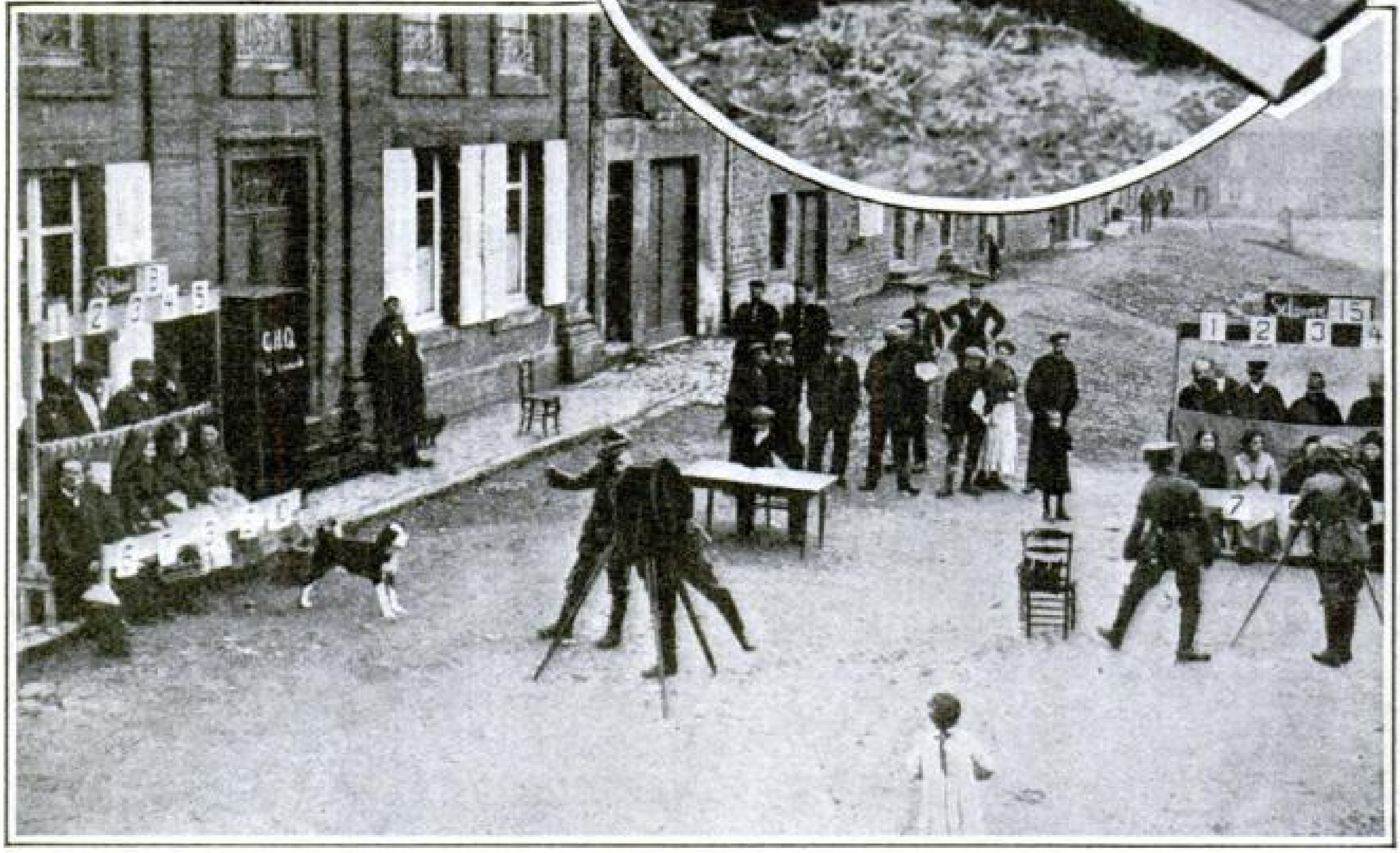
The heavy wheel of a motor-truck shoots pebbles that break unprotected windows

The principle involved is the same as that practiced in "shooting cherry stones" by pinching the slippery stones between the fingers. In this case, though, much higher velocities are attained because of the enormous loads now being placed on trucks.

There's more to War than Shot and Shell

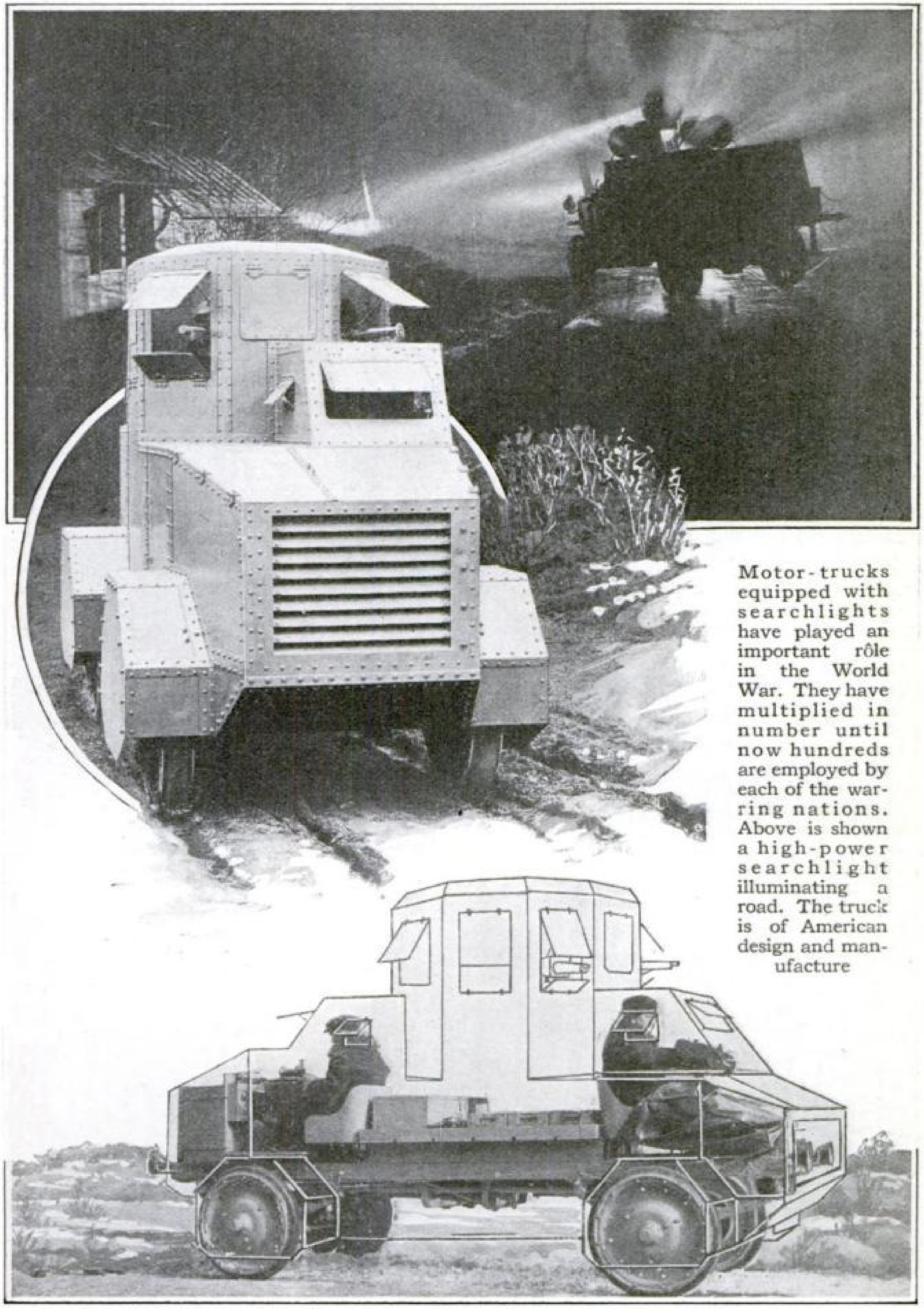
At left, Germans establishing a great army telephone exchange somewhere along the southeast Russian front. Below, oil-can, lantern and measuring cup—part of a German officer's outfit

At the right are shown men developing and printing plans at the front, for the use of aviators and officers



In Russian Poland, the German officers keep an accurate record of every peasant by means of his photograph. Ten pictures are taken at one sitting and then cut apart with their respective numbers. These are then filed with the military governor

Refinements in War Motors



Motor-trucks equipped with searchlights have played an important rôle in the World War. They have multiplied in number until now hundreds are employed by each of the warring nations. Above is shown a high-power searchlight illuminating a road. The truck is of American design and manufacture

An American manufacturer has designed a truck operated from both ends. When beset by the enemy the crew need not turn around. The car fitted with an armor body is shown above at the left, while the stripped chassis may be seen below, the superstructure being drawn in faintly to show the positions of the drivers

The David and the Goliath of the Skies

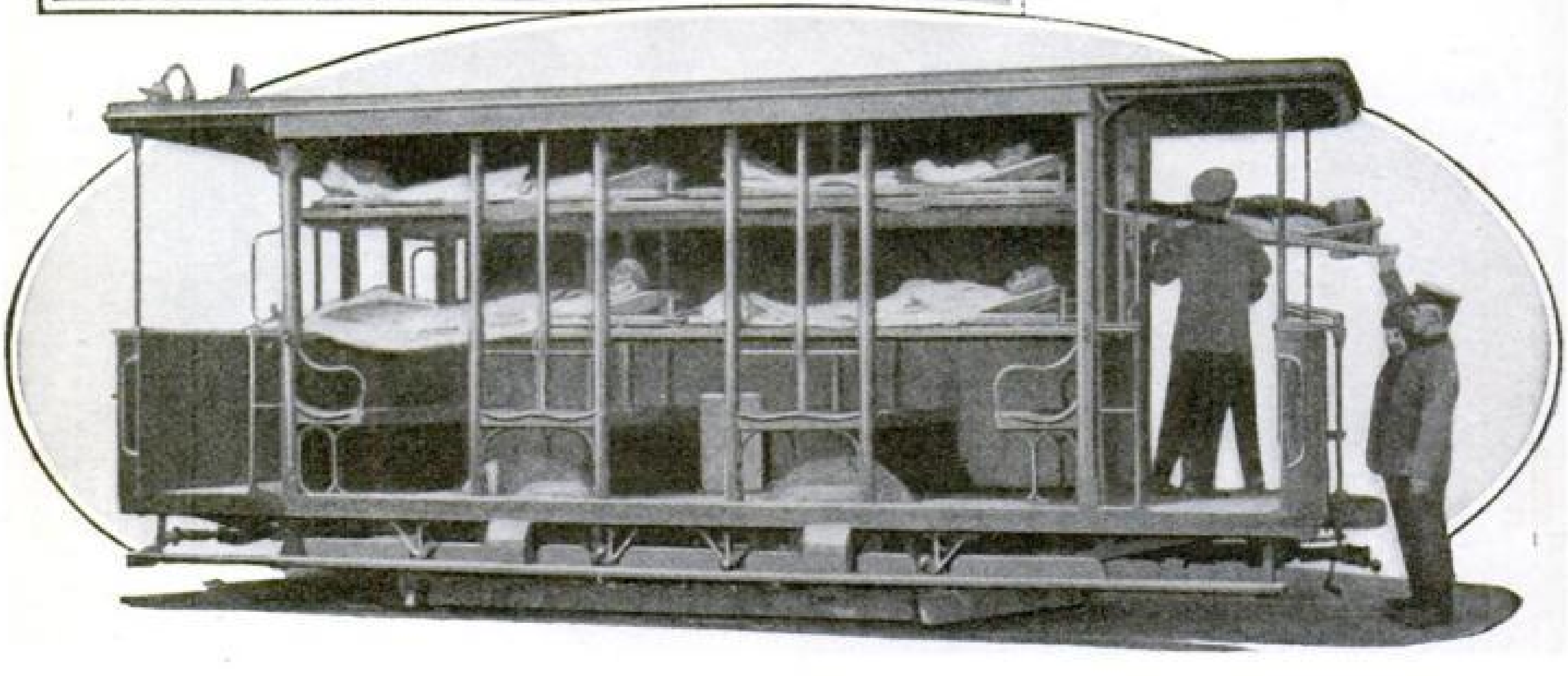
One of the most remarkable photographs yet received from Europe. A German Zeppelin falling from the clouds after being hit by an explosive shell from the French aeroplane seen in the center of the picture. The photograph was taken from a German trench

A Gas Attack Seen from an Aeroplane

A remarkable photograph taken from a British aeroplane showing German troops massing behind a cloud of poisonous gases, blown toward the Allies. Shells fired by the Allies may be seen bursting within the German lines, and in the French village in the background

New Activities of Military Surgeons

All the luxuries of a Turkish bath may be found in these tents, which have been recently presented to the French Army. A number of them are now to be found near the trenches. They are considered a boon by the officers and men



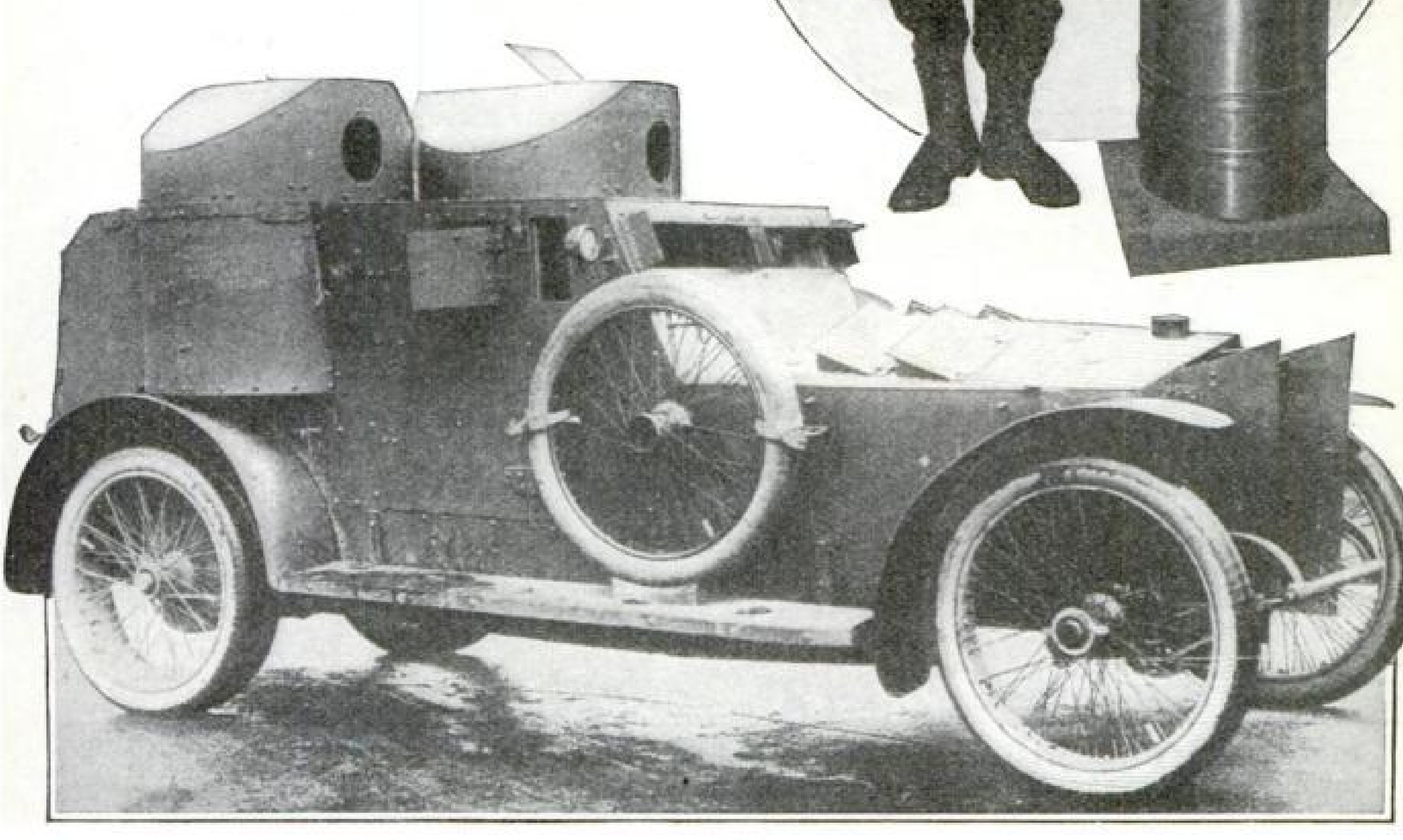
The versatile Germans are even using streetcars as ambulances. Capable of carrying eight stretchers, these cars take the sufferers from the railroad station at Düsseldorf to the base hospitals in comparative comfort

Keeping the Germans from Verdun

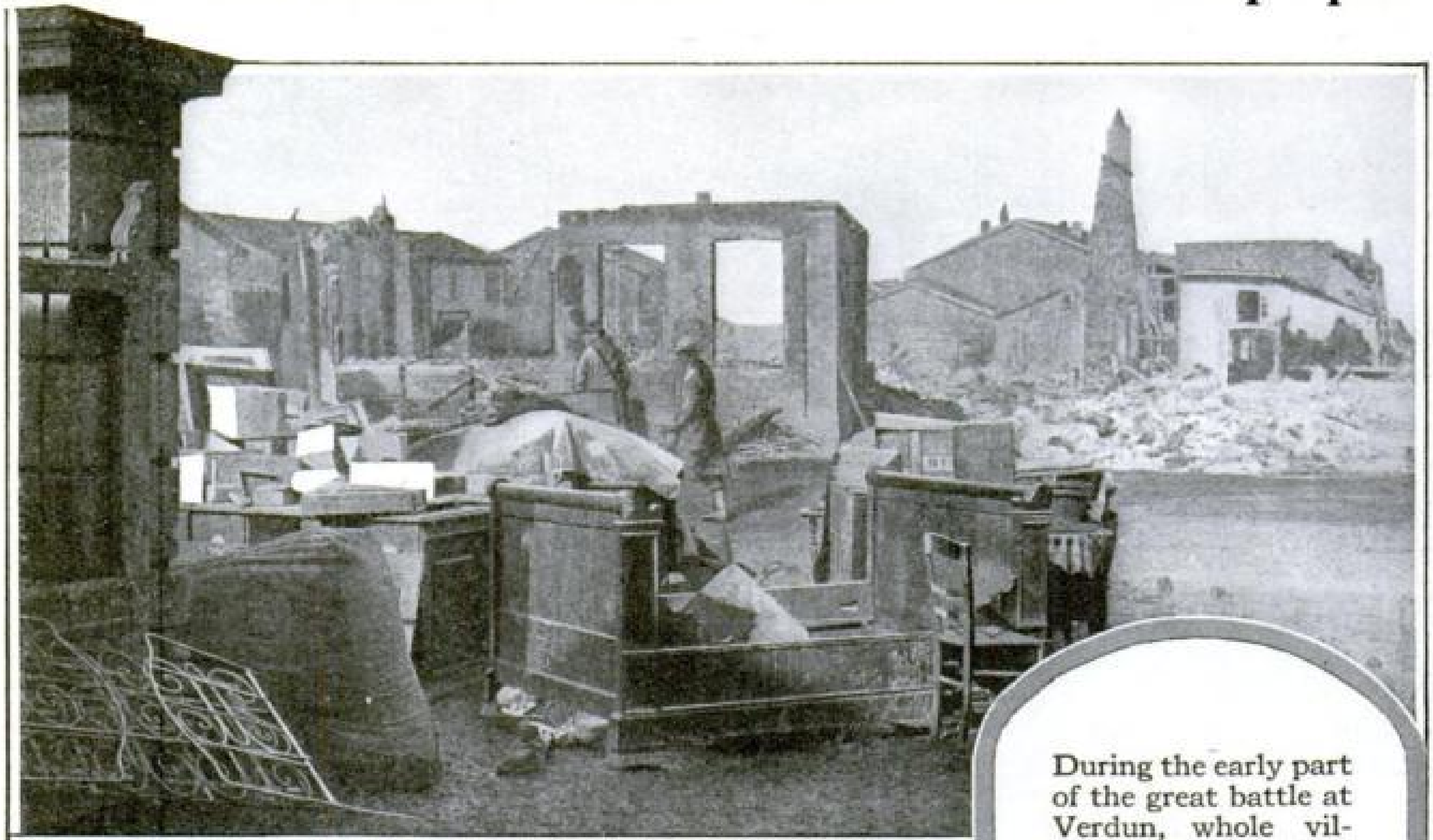
A mistake in the handling of supplies during a great battle might easily result in defeat. Behind the French lines at Verdun, the work is carried on with accuracy and speed which are amazing

At right, a Giant 16-inch French shell, designed to rival the famous Austrian Skoda projectiles. The new French guns which fire these shells are manned by crews of sailors taken from the fleet

Below, the latest development in French armored motor-cars. The distinguishing feature is the use of two turrets for guns



What the Battle of Verdun Means to the Townspeople



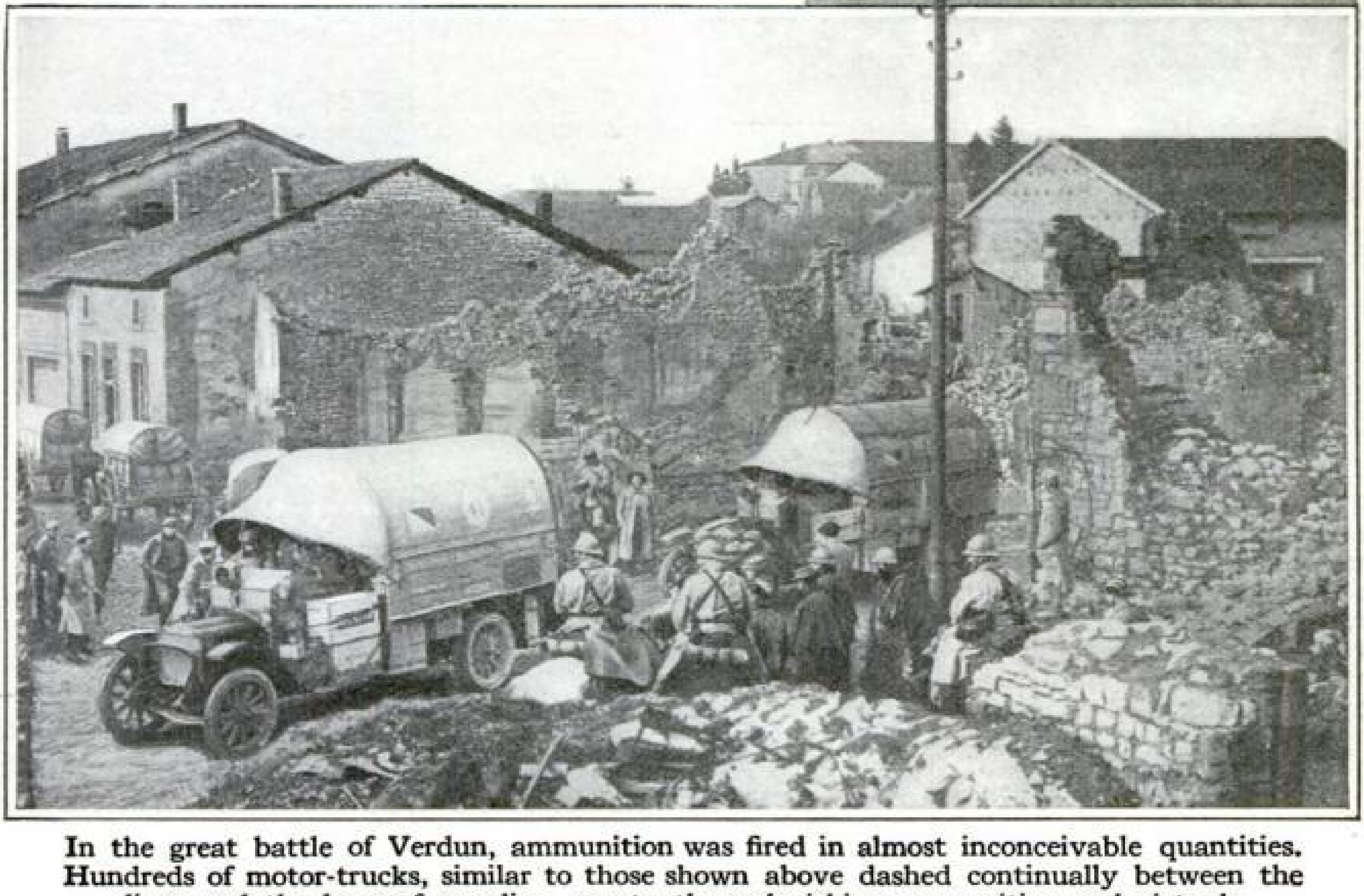
During the early part of the great battle at Verdun, whole villages were destroyed by the on-sweeping Germans before the inhabitants had time to save their household belongings

In the path of the German drive on Verdun troops aided the terror-stricken inhabitants in saving their property, often at great personal danger. After all the available horses were pressed into service, the wagons and carts were drawn to safety by hand

From the World's Greatest Battle-Ground

At the scene of the world's greatest battle. Dummy-trench mortars behind the French lines at Verdun

A queer result of a high-explosive shell is shown to the right. In a French church a statue was struck by a shell. The statue was broken into fragments, but the head was hurled against the wall with such force that it was embedded in the masonry



In the great battle of Verdun, ammunition was fired in almost inconceivable quantities. Hundreds of motor-trucks, similar to those shown above dashed continually between the lines and the base of supplies, constantly replenishing ammunition and victuals

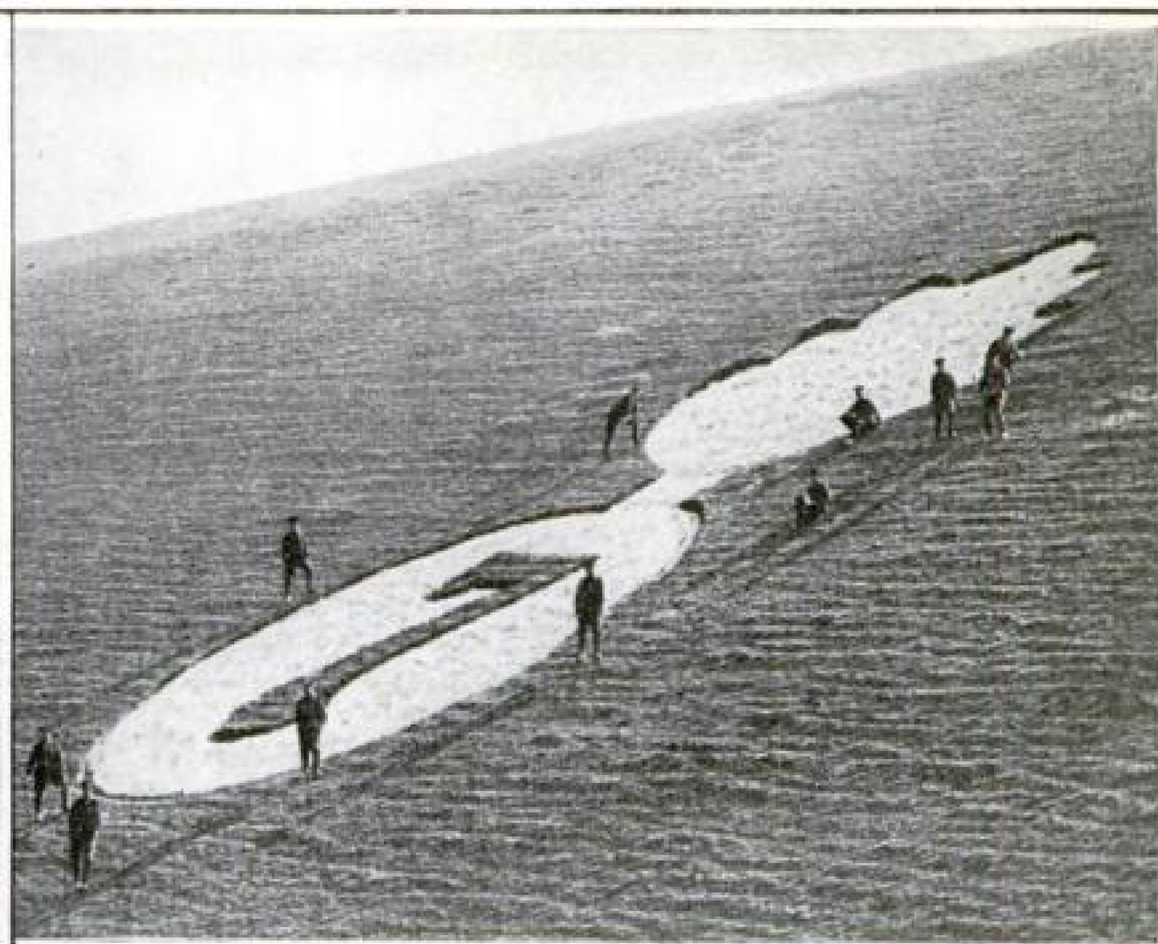
Glimpses of the French Trenches

A passageway in the "Ravine of Death," a position disputed for many bloody months, and finally carried by the French at the points of their bayonets. The effect of German shell fire is evident enough in the torn and leafless trees

To the left, masked French soldiers emerging from a subterranean shelter

Something new in trench warfare is shown in the picture to the right. The French have named this strange weapon a "revolver gun," possibly because of a remote resemblance to the familiar "six-shooter"

"Somewhere in France"

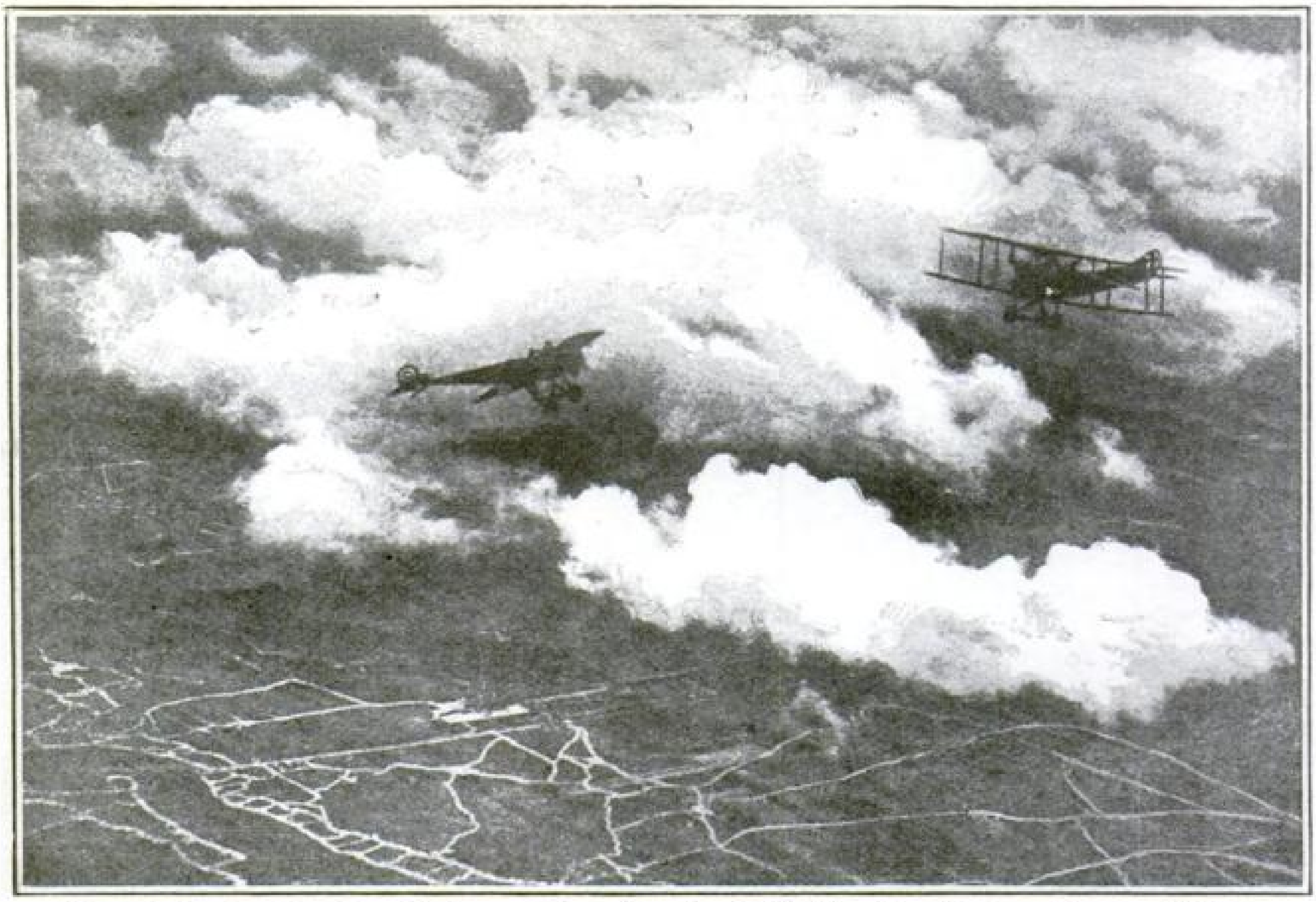


A regimental badge cut in a hillside on the first anniversary of the Seventh Battalion of the London Regiment

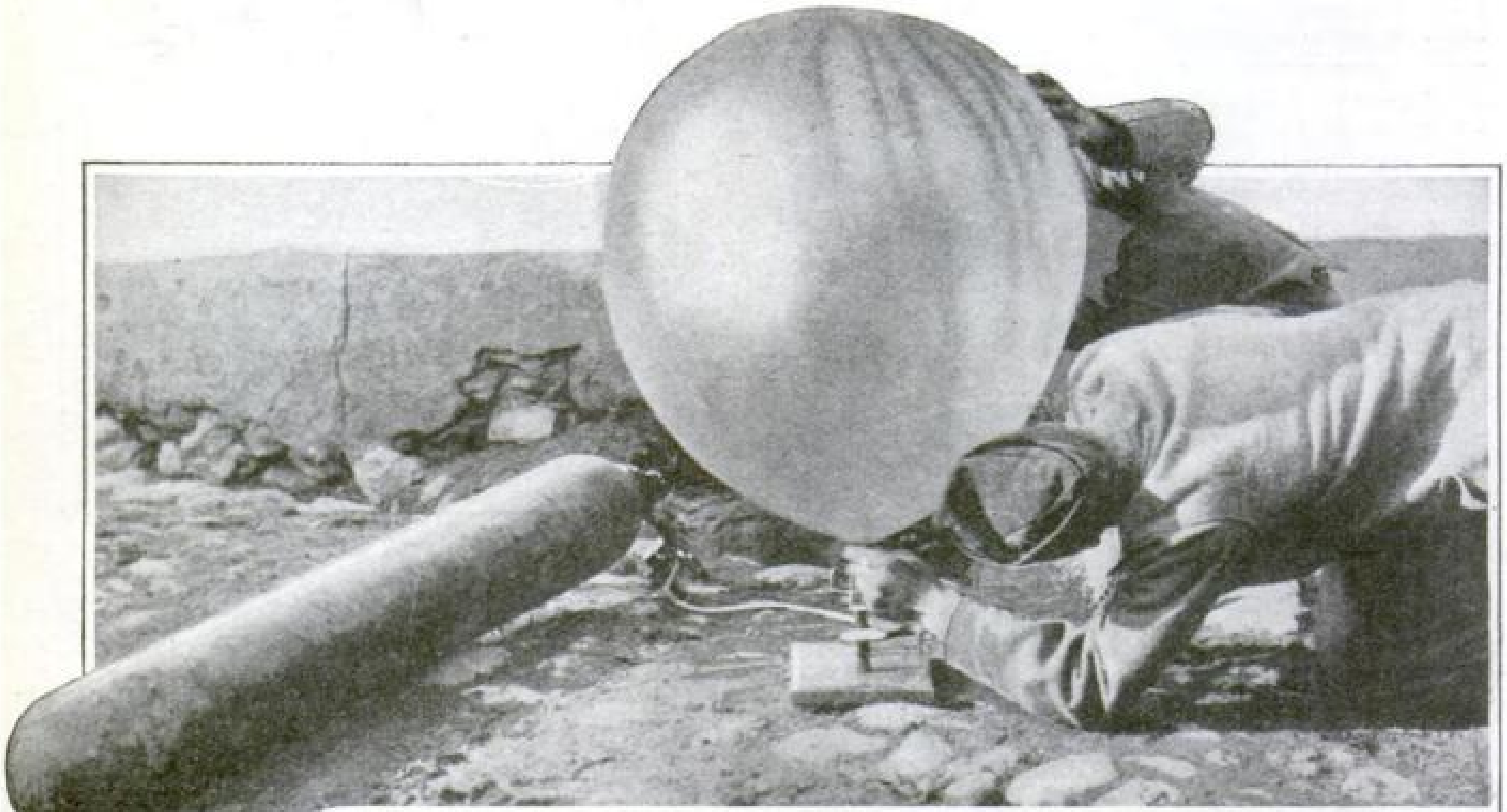
Above, bailing out a flooded German trench "somewhere in France." Below, French soldiers drawing their weekly ration of tobacco. One French general presented his troops with ten thousand cigars and cigarettes

Behind the battle line at night. This windmill was suspected of being a German observation post. One or two well-placed shells reduced the dangerous structure to a pile of smoldering ashes in a short time

The War in the Clouds

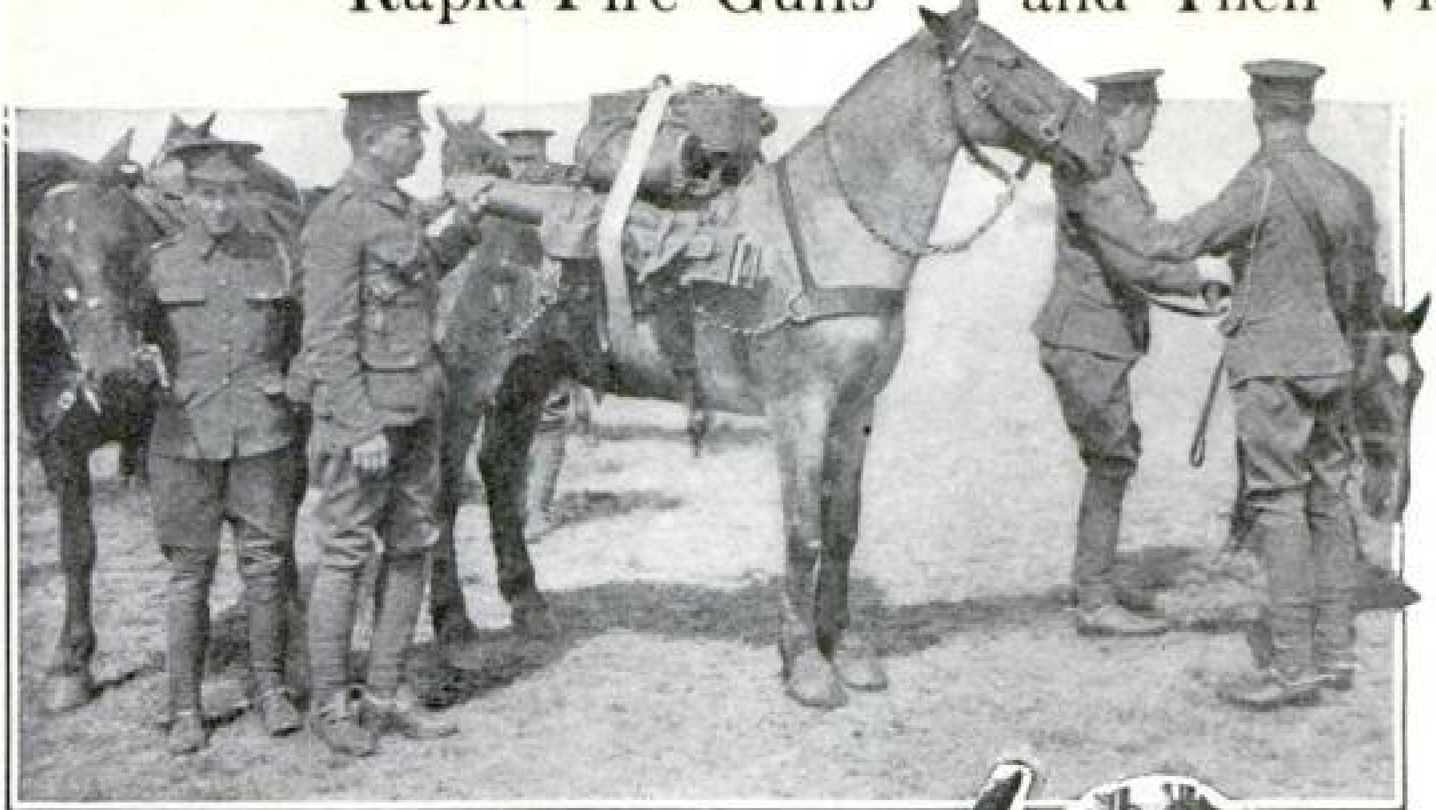


A battle in the air. An allied monoplane (on the left) rising to attack a German biplane among the clouds over the war front in France. The photograph was taken in mid-air by a third aeroplane, and shows clearly the trenches over which the machines are battling



An Austrian pilot balloon being inflated from a gas cylinder. These small pilot balloons are sent aloft just before a Zeppelin foray in order to determine the direction and velocity of the air currents. In time of peace they are employed to obtain temperature readings of the upper air for the use of meteorologists

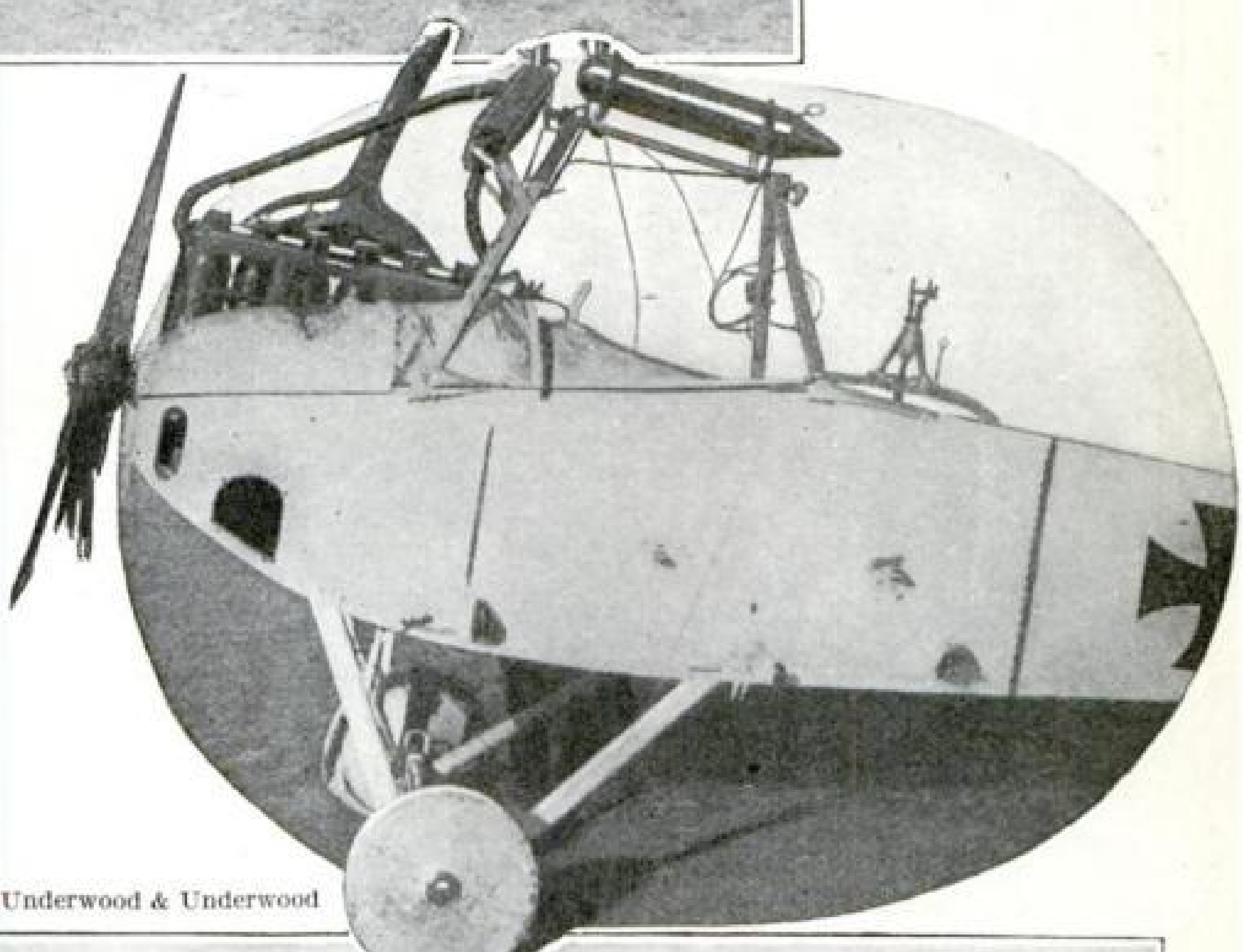
Rapid-Fire Guns and Their Victim



A new British machine-gun equipped for cavalry work. The gun is extremely light, and may be easily carried on the back of one horse. In an emergency it may be assembled for action in a very few minutes

At right, the first of the famous Fokker monoplanes to fall into the French lines. These light and speedy machines played havoc with the Allied air forces. They are little different from the familiar French Morane except that they are overpowered, thus gaining great speed

Below, the warning cry "A Taube" sending the men of the anti-aircraft automobile crews sprinting to their cars. The motor-cars are equipped with high-angle rapid-fire guns



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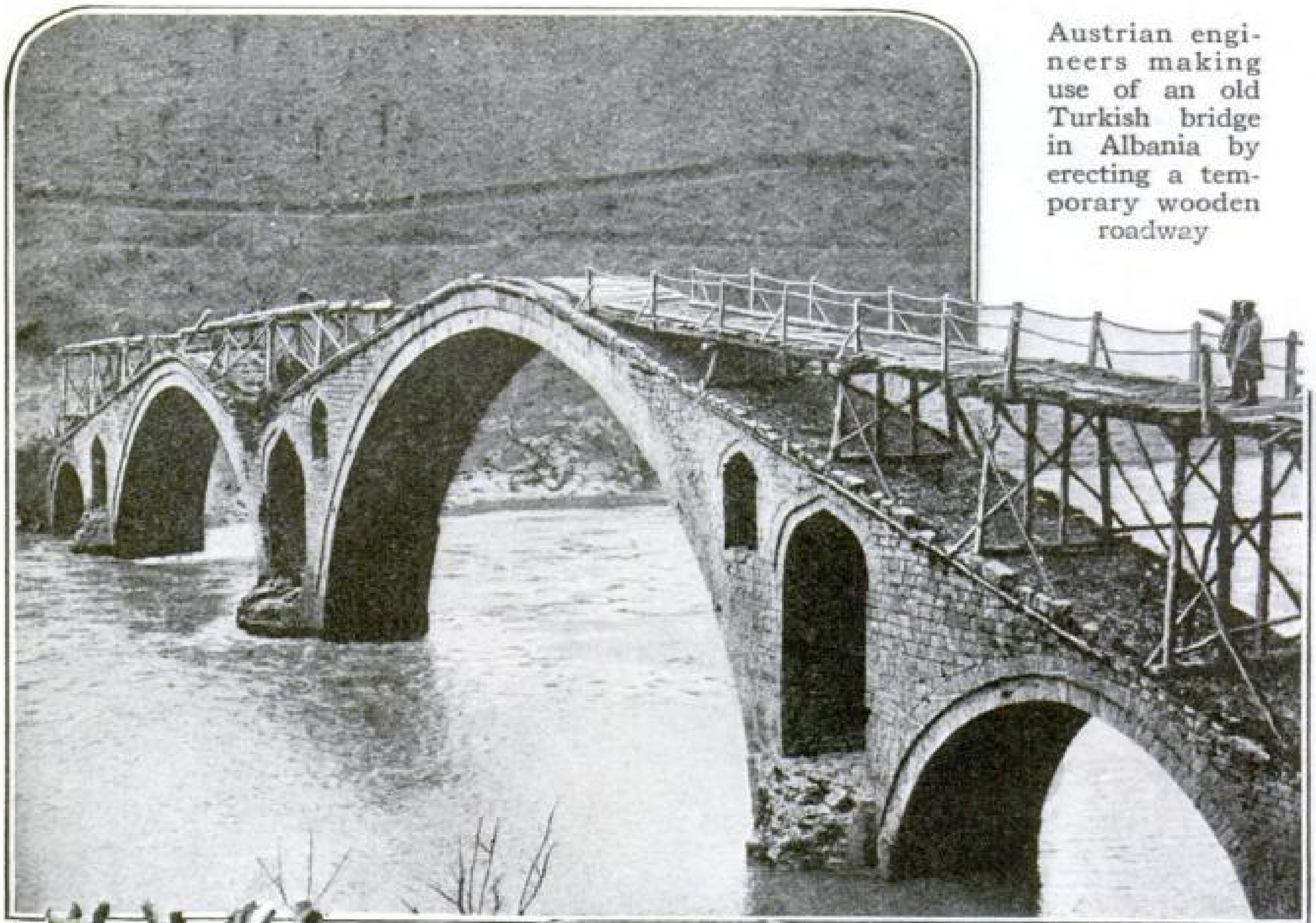
Overcoming Difficulties in Albania



Austrian engineers making use of an old Turkish bridge in Albania by erecting a temporary wooden roadway

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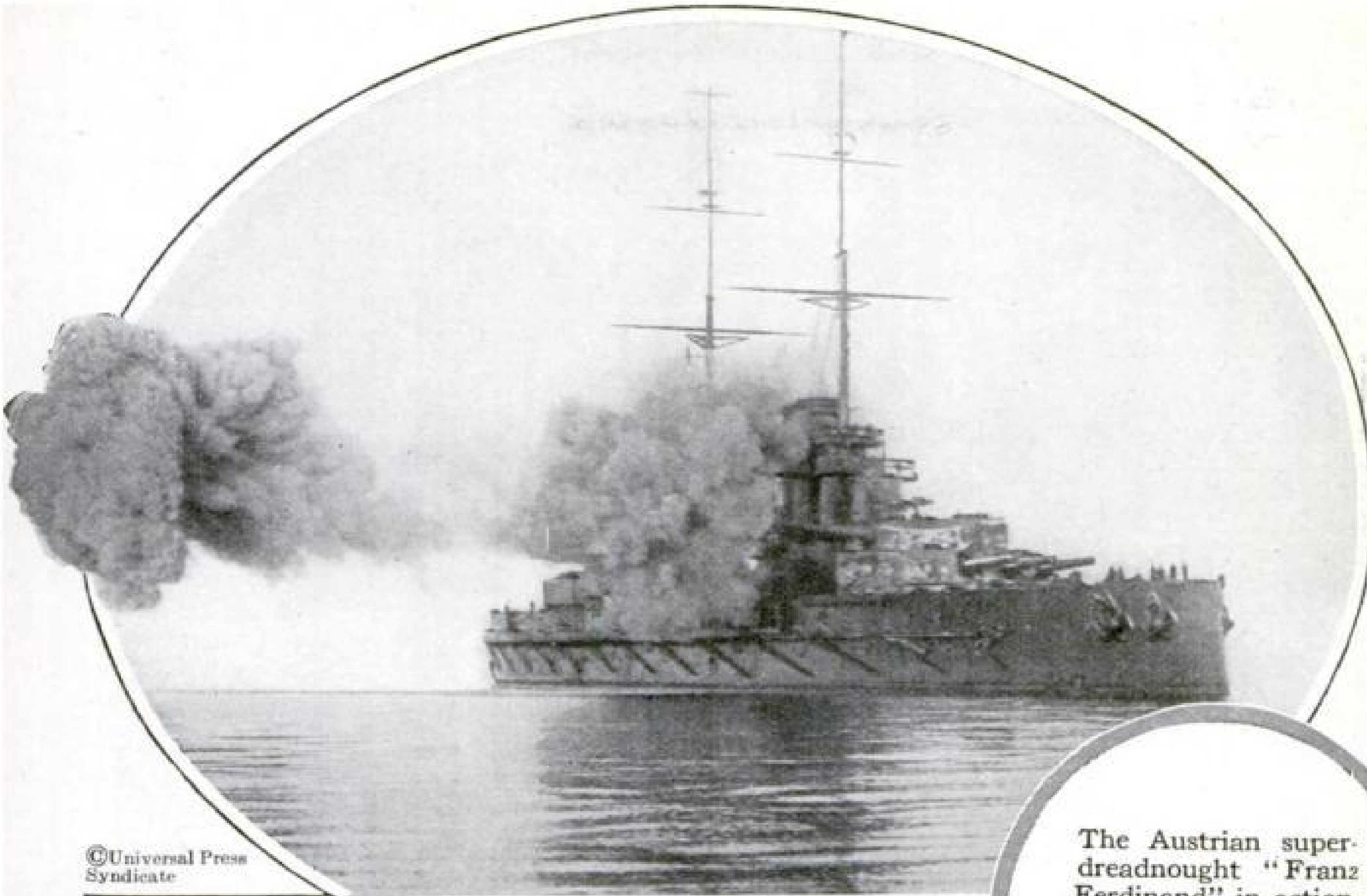
This picture shows the bridge in the foregoing illustration in course of construction. Obviously the purpose was to get rid of the picturesque but awkward inclines as well as to repair damage

On the High Seas with the Battleships



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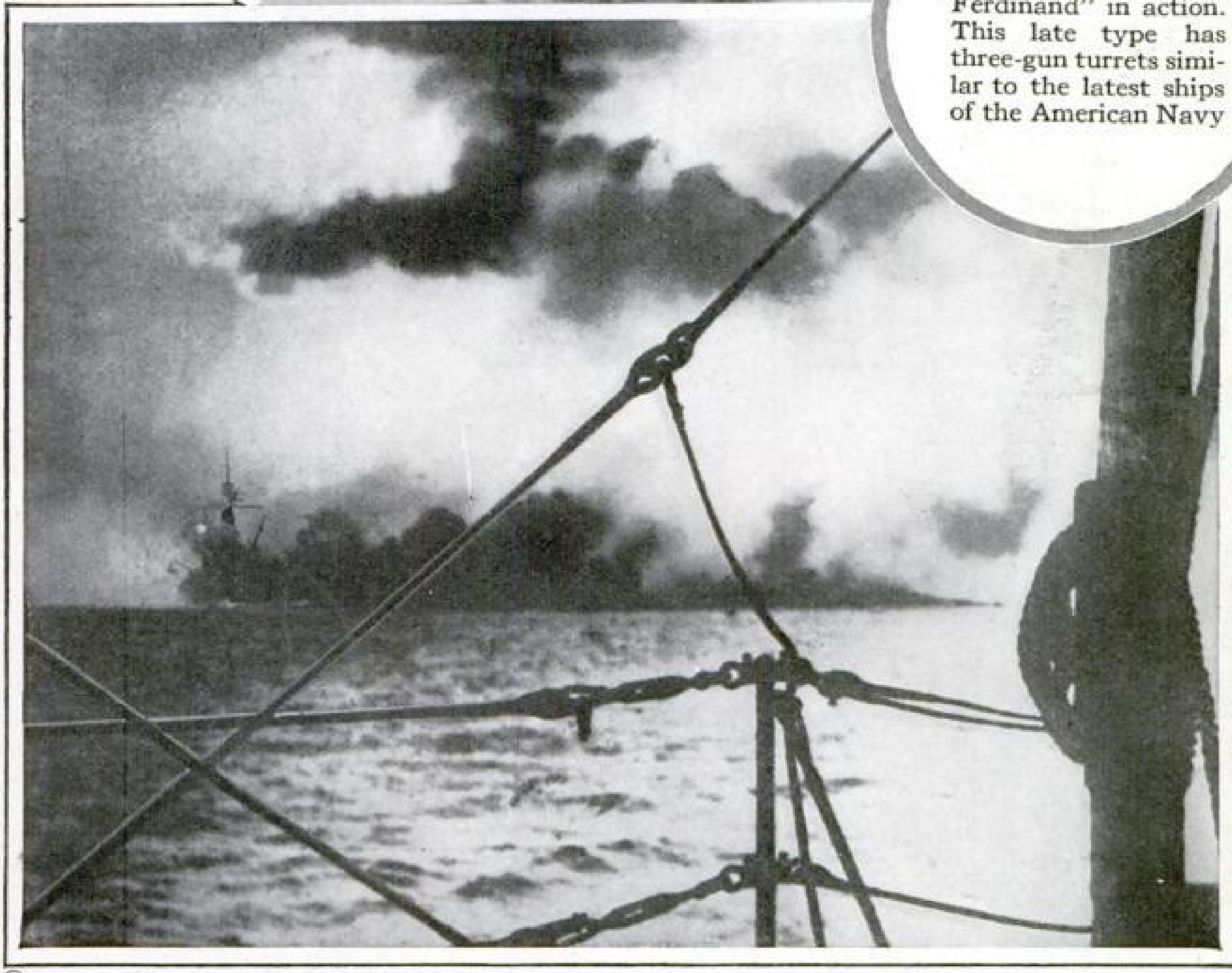
The Austrian super-dreadnought "Franz Ferdinand" in action. This late type has three-gun turrets similar to the latest ships of the American Navy



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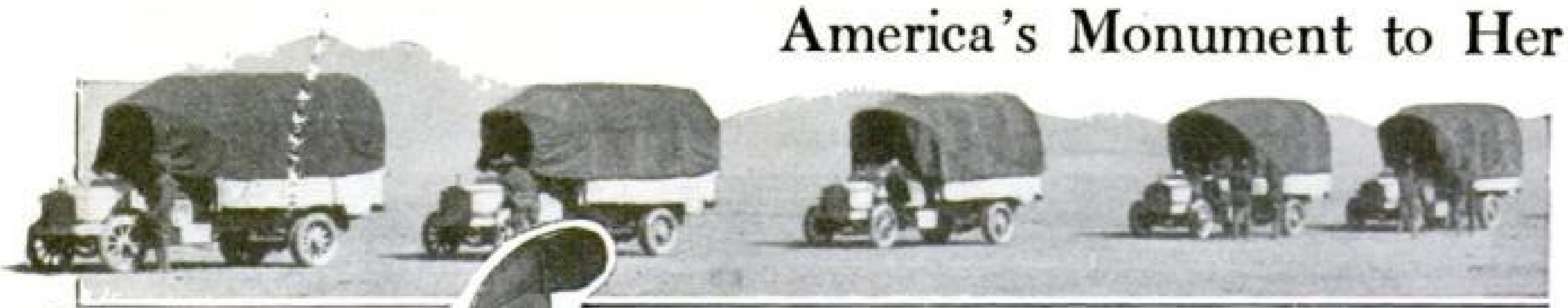
A battle between a British dreadnought and a German raider in the North Sea. The reddish gases of smokeless powder photograph black. Hence the black clouds

America's Monument to Her



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Above, the fleet of motor supply-cars with which the United States Army should have been provided years ago. The lack of such vehicles caused a long delay in crossing the Mexican border. The army officials had to advertise for motor-trucks. On the night that war was declared in Europe, thousands of motor-trucks were on their way to each strategical point

Below, one of our crude field kitchens. Another item of American equipment which compares very unfavorably with that in the European armies. This kitchen is heavy, cumbersome, and cannot be used en route

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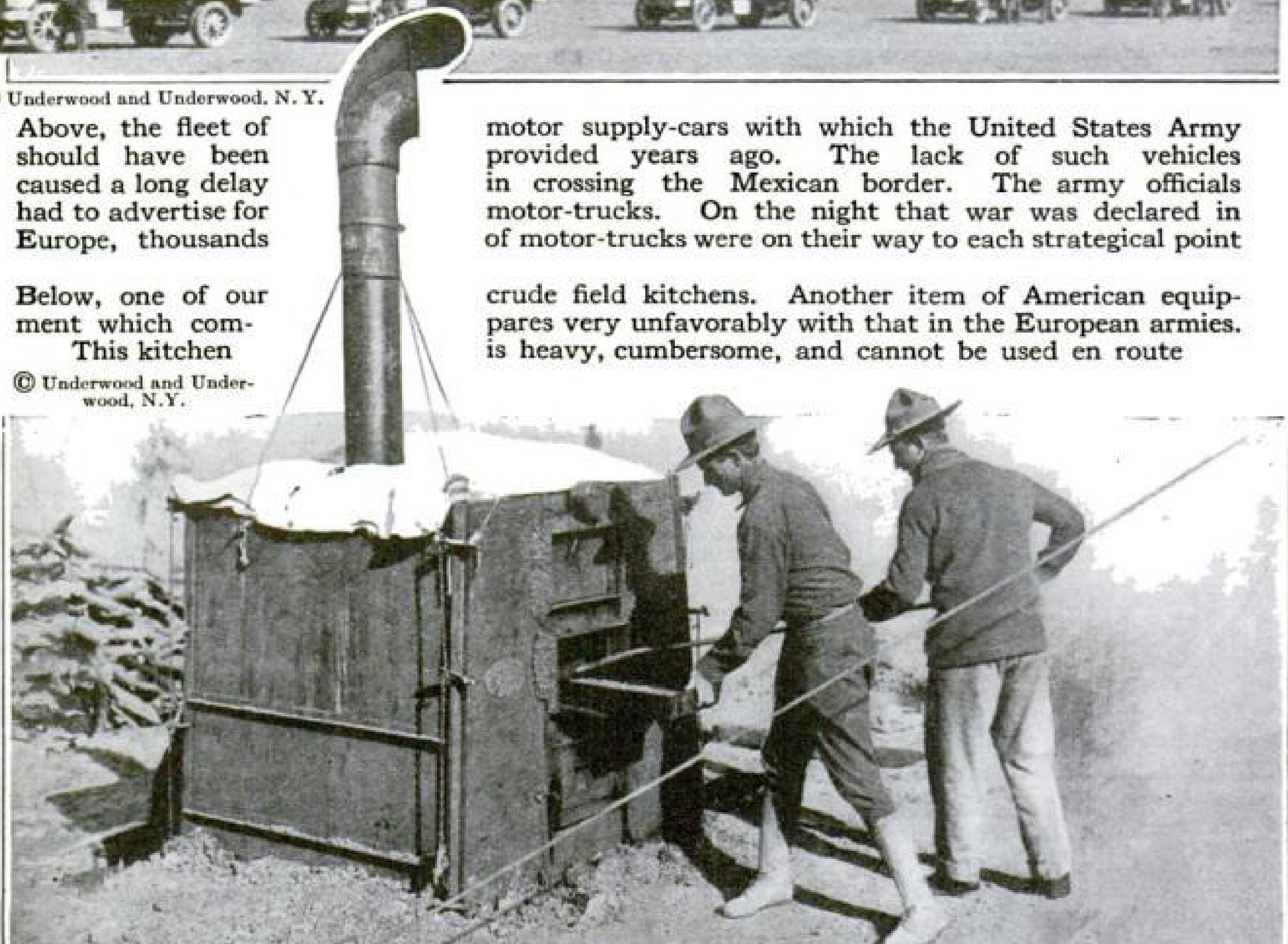

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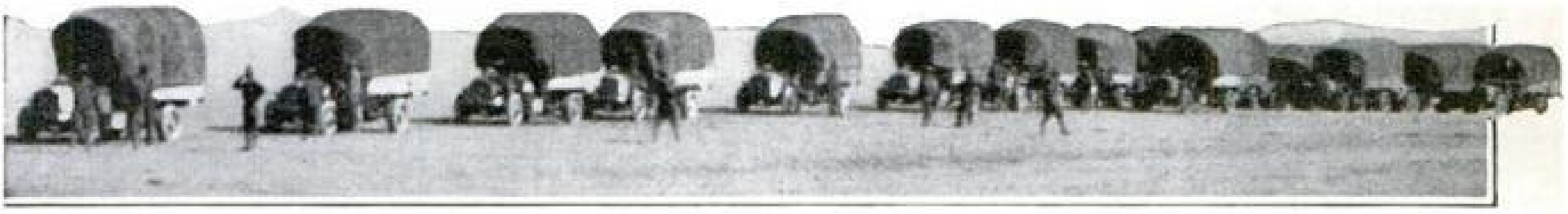
A system of signaling borrowed from the Indians. A squad from Troop E, Twelfth United States Cavalry, sending up a smoke signal to apprise the rear guard of their position. In the wide expanses of Mexico, where the human eye can detect with remarkable accuracy objects fifty to seventy-five miles away, the smoke signal represents the most effective means of giving information when wireless and telephone are not available

Policy of Unpreparedness



At the end of a six days' march southward into Mexico. With the limited forces and inadequate equipment at their disposal, the United States troops have acquitted themselves very creditably. The truck shown is equipped with flanged steel rims fitted over the wheels. It can run on the railroad tracks, and with but slight alterations can again take to the roads. Several of these versatile vehicles were recently forwarded to our army at Columbus, New Mexico

Three levels of track are visible in the zig-zag course up the precipitous mountain side

Hairpin Curves on a Mountain Trolley Line

THERE is an electric trolley trip up the face of Mount Lowe in Southern California, which, so Europeans have said, equals in thrills and actual interest any of the Alpine or similar jaunts in Europe.

The start is made in an ordinary surface car, which tackles the massive base of the Sierra Madre range by a succession of violent curves, then pursues at a modified clip a series of hairpin turns, which are perfectly safe, although it seems that the car must be hanging on by its very eyebrows at times.

At one particular point in the journey, where the car weaves in and out as it climbs its zig-zag course up the mountain side, three cars may be seen at one time, one directly above the other on the various levels.

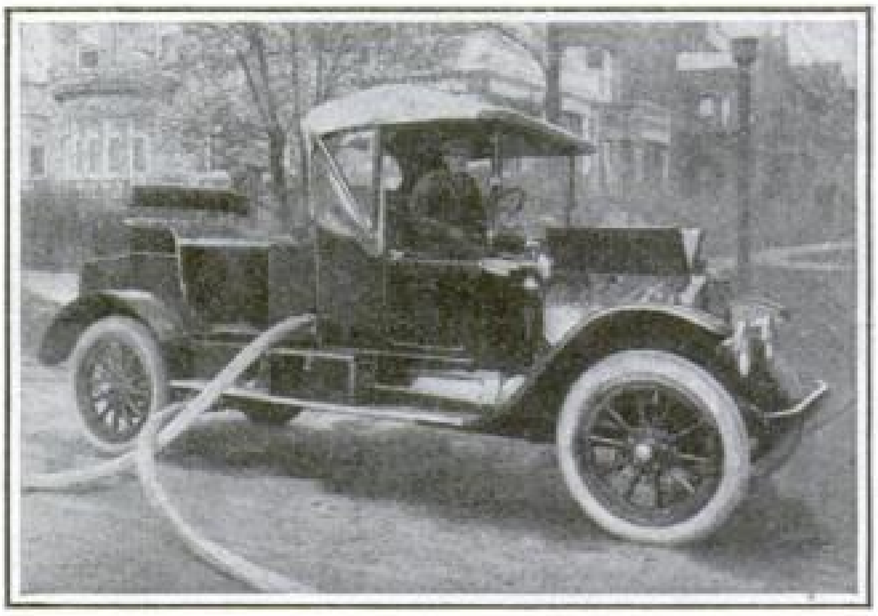
Far to the south, as the car ascends, the blue chain of the Temecula Range rises up from the valley. Villages, farms, ranches take on a strangely dissembled and isolated appearance.

The last stop of the car is made at Echo Mountain, where at night a five-foot searchlight throws a questioning shaft of light into the depths below. Close at hand is the Mt. Lowe astronomical observatory, which is opened several evenings in the week to visitors.

How an Automobile-Engine Tests Water-Mains

BY means of a centrifugal pump driven by an automobile-engine new water-mains are being tested in Chicago. The work was formerly done by a triplex pump driven by a gasoline-engine, all mounted on a wagon. As most of the pipe-laying is in the outskirts of the city a twenty-five mile drive with a team at six dollars a day to cover one job was not infrequent.

With the new automobile apparatus it is now possible to cover four or five jobs per day in different parts of the city. The number of tests has been increased one hundred and fifty per cent, and practically all jobs are tested. The pump was specially designed for the purpose and rests in a horizontal position. It is driven by the truck through an extra sprocket and a silent chain without any reduction from the speed of the engine. Two men make the tests. One operates the engine and the other reads the meter.



The automobile-engine drives a centrifugal pump, testing water-mains in a minimum of time

Your Mainsail and the Wind

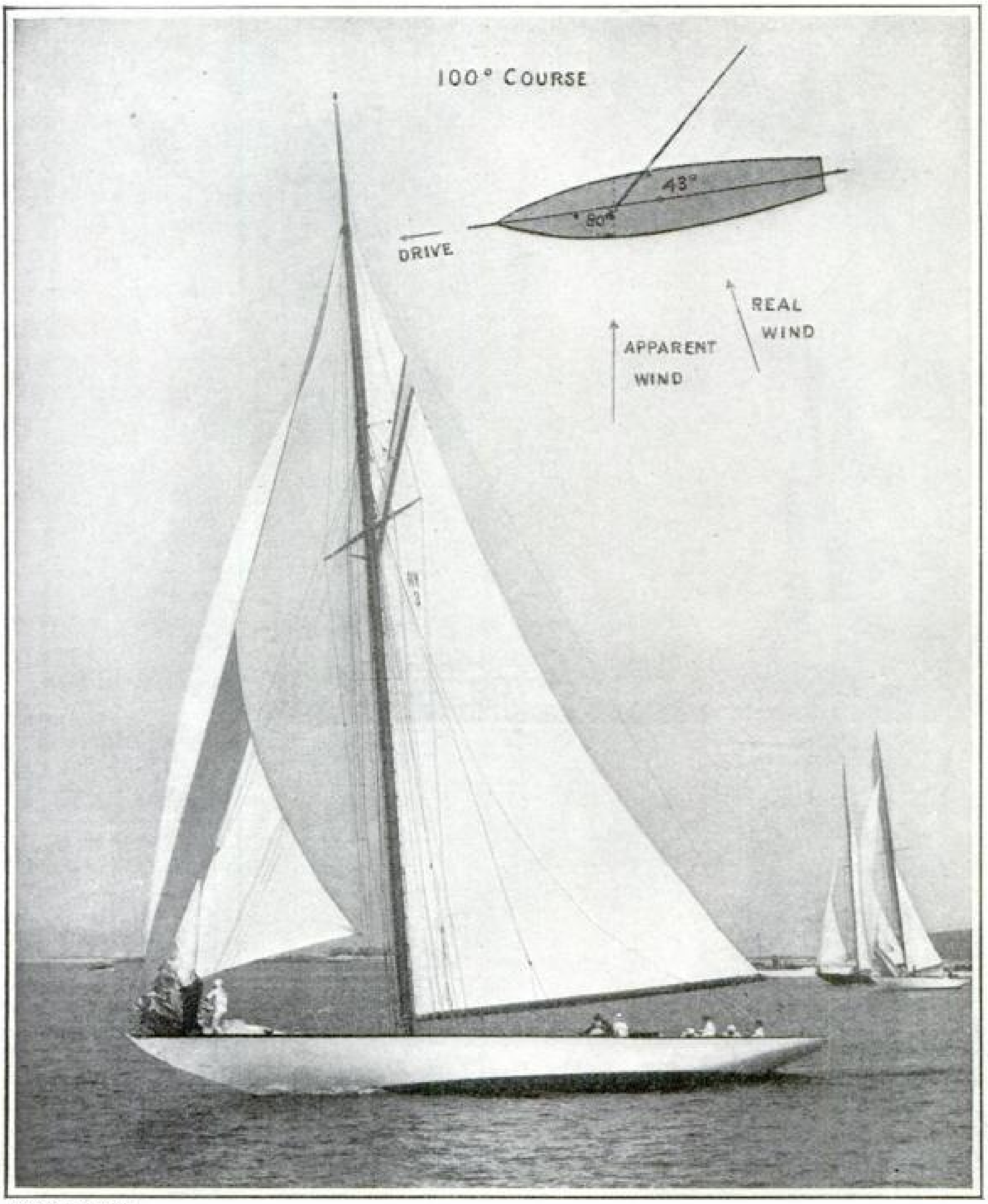
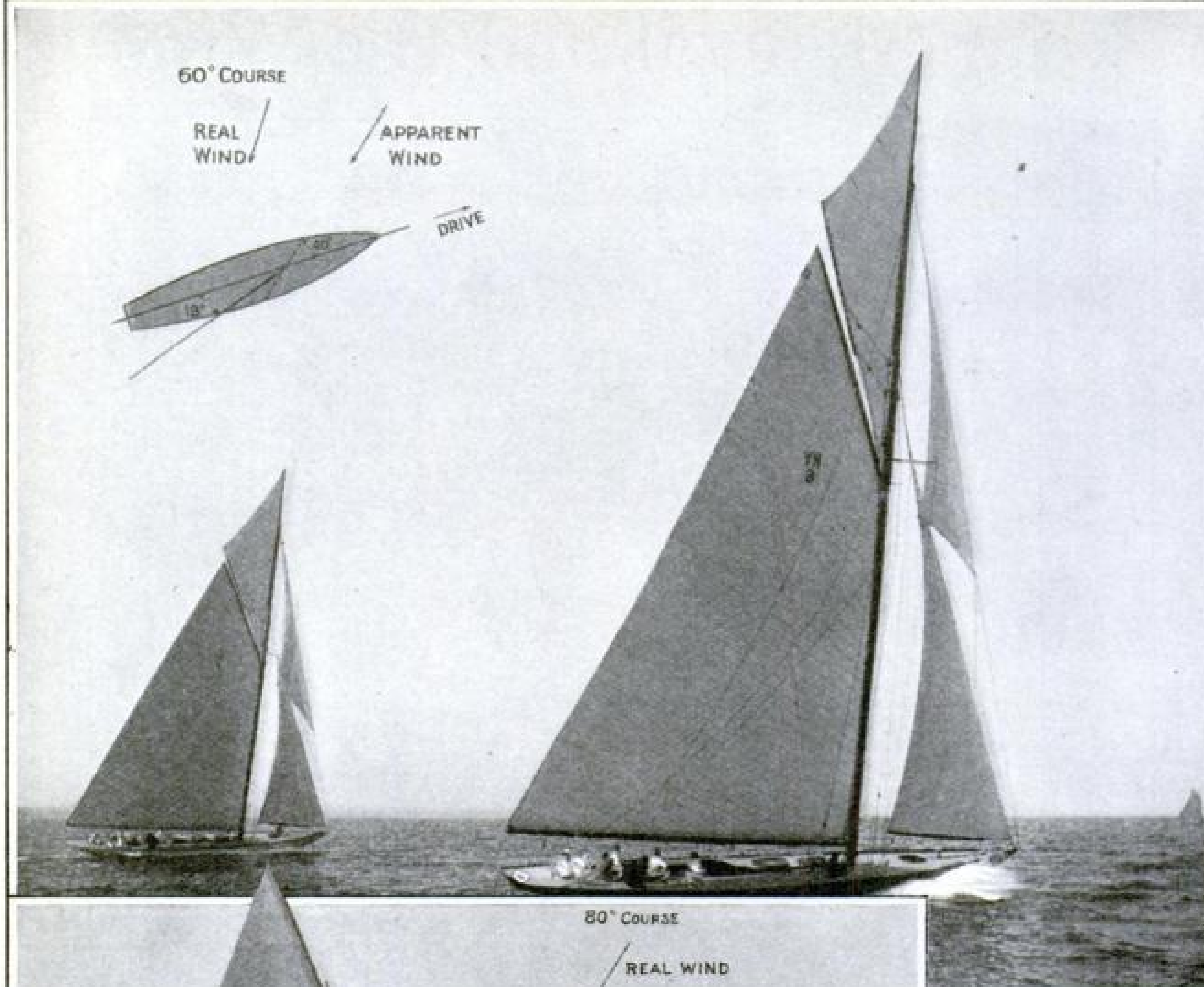


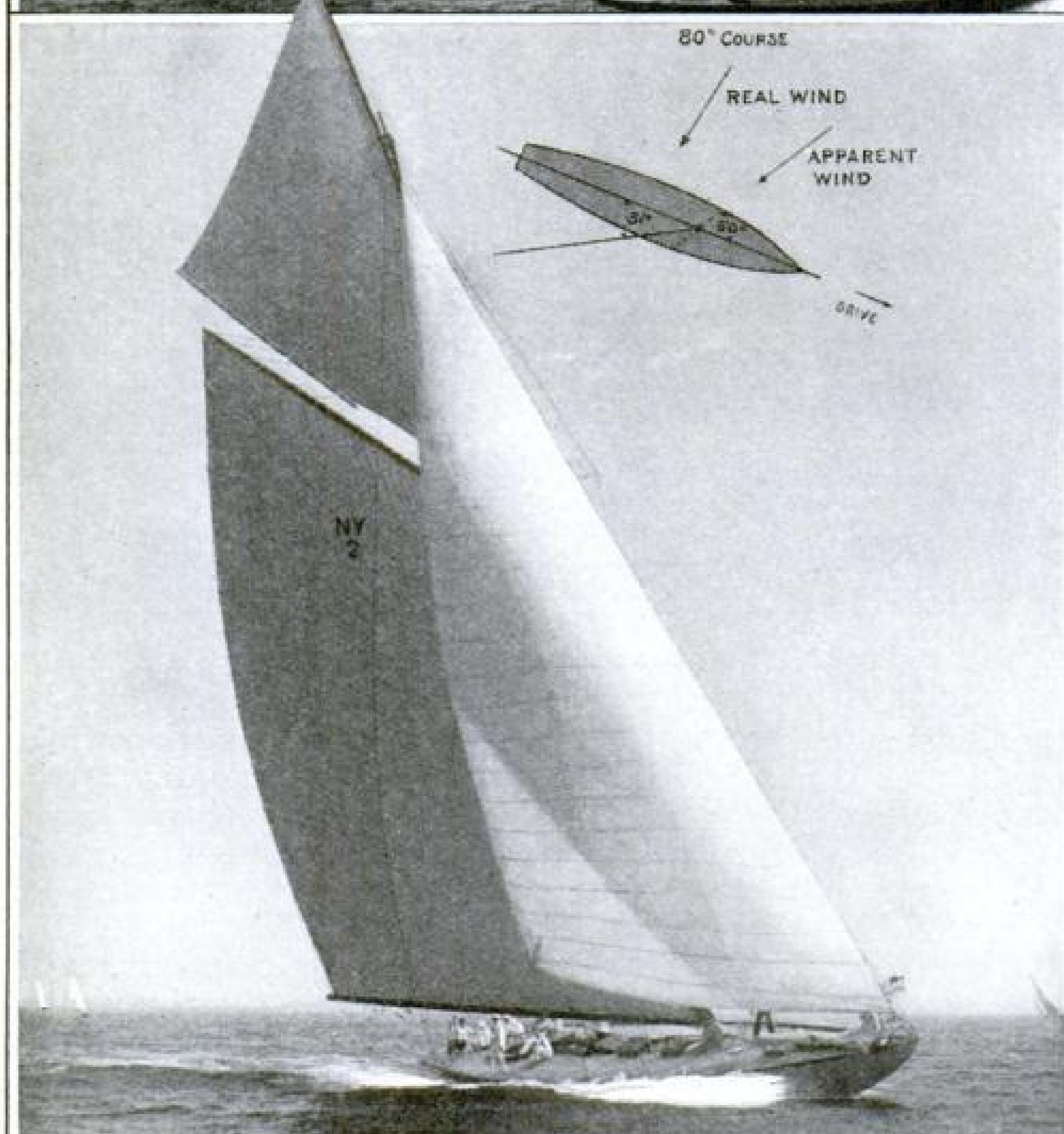
Photo by Levick

The boom makes an angle with the boat to secure the highest possible speed

AN interesting and practical series of experiments in a field that is new to science has been made at the Massachusetts Institute of Technology by Professor H. A. Everett, for the purpose of determining some of the facts about the propelling power of sails. By dint of experience and by rule of thumb certain practices are common in sailing boats. Skippers agree in the main about these practices, but there are individual variations from any rule. Each man maintains and asserts that his is the proper way. What Professor Everett has done is to determine scientifically certain elements common to all sails with regard to thrust or propelling power, and twist, and to establish certain fundamental principles which fix the relations of sails to direction of the wind.

In Boston Professor Everett was

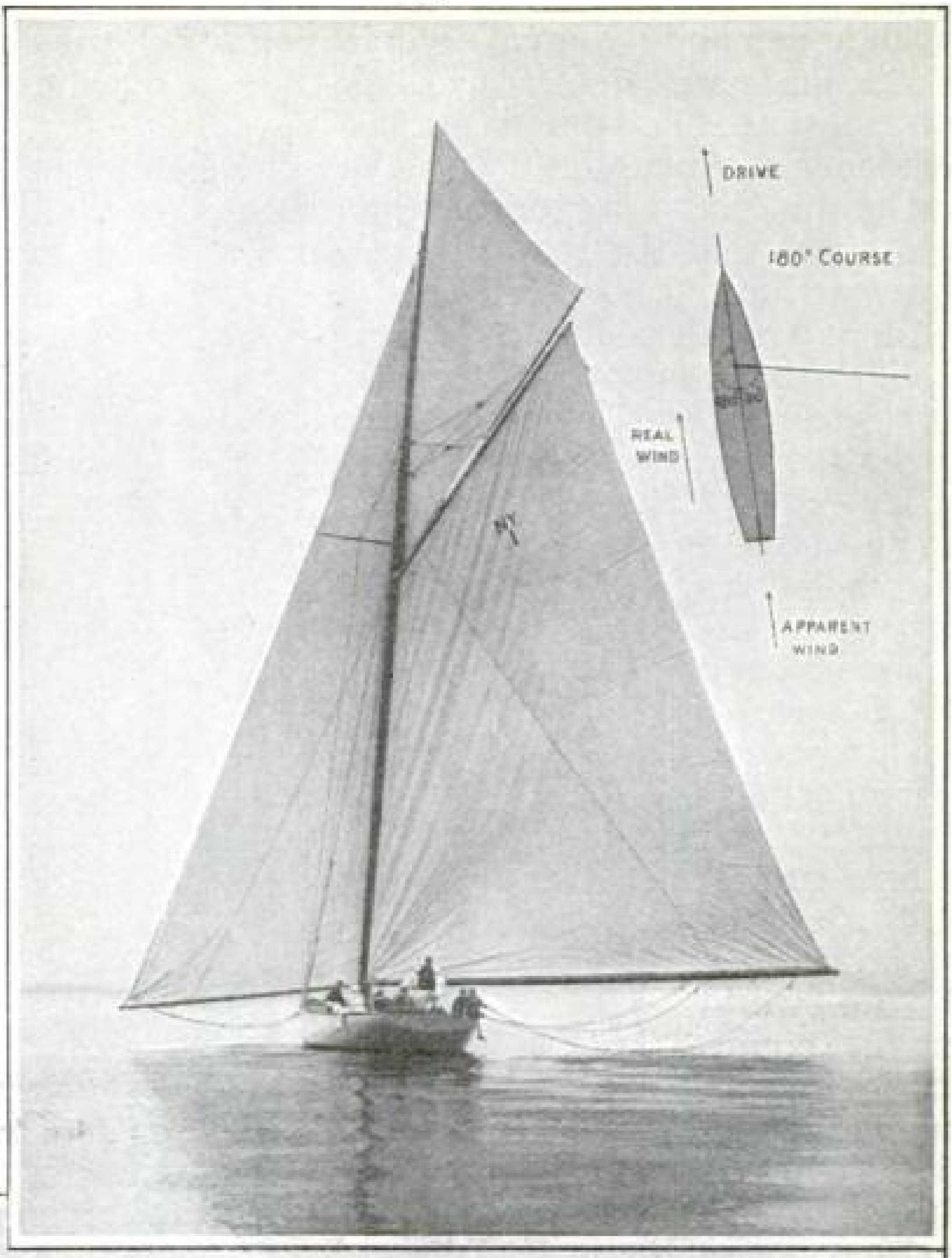




Photos by Levick

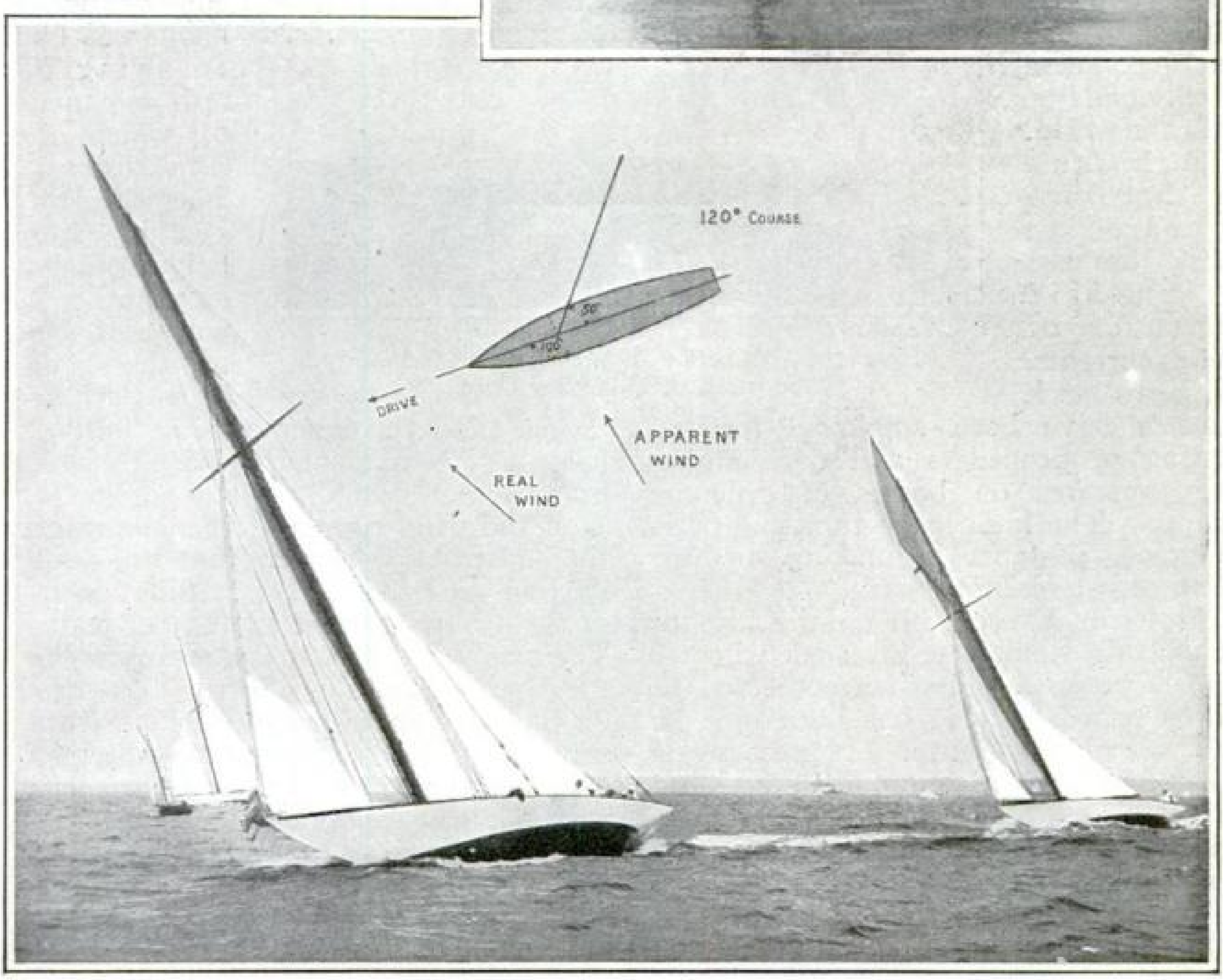
The wind which is customarily observed is that indicated by the fly at the masthead. The fly generally shows the skipper the apparent direction in which the wind is blowing. Professor Everett made experiments in a wind tunnel which show that yachtsmen do not fully appreciate the mechanical forces at work

The apparent wind is the resultant of the speed of the boat and the true wind



Assuming that the hull resistance is not affected by different angles of keel, the course at 190° with the wind is the one in which the boat will make the fastest headway. In the wind tunnel of the laboratory the construction is such that uniformly moving currents of air without swirls in them blow against the object tested. The mast with its sail is set up within the tunnel, and the effect of the wind in the sail is measured. The sail is set at different angles to the direction of the current of air

For courses from 45° to 160° the angle between the boom and center line of ship should be one-half the angle between the fly and center line of ship. In the wind tunnel measurements are made at each angle of the direction of the current of air. The thrust and twist are measured, the experiments being repeated many times with different wind velocities. It is the apparent direction of the wind that concerns the sailing man



Photos by Levick

much in demand by naval organizations. Since last September he has been professor at the United States Naval Academy at Annapolis.

The underlying reason for the experiments was that the Institute has within three or four years established courses in aërodynamics, for the purpose of familiarizing young men with the design and construction of aeroplanes and airships. For the laboratory work in connection with these courses the Institute has had installed a wind-tunnel and accompanying equipment.

The tunnel is one of the important ones of the world and is equipped with an "aërodynamical balance" unique in this country. There is only one like it in the world. The Institute is therefore prepared to work on the scientific features of wind-currents. Hitherto such tunnels have been employed for the testing of propellers and determining the pressures on bodies of different shapes. The knowledge thus gained is of great assistance in making airships of the least resistant form.

Professor Everett hit on the idea of using this tunnel to discover what is the effect on a sail when subjected to different winds. He has been able to tell where the center of pressure is located in a sail, the amount of pressure for a given wind velocity and the angle which the boom should make with the longitudinal axis of a boat.

The experiments were made with a single sail, a mainsail, copied exactly on a scale of 3/8 of an inch to the foot from a winning model of last season. The original was known to be a successful pattern and the miniature sail was carefully cut and made in precisely the same proportions as the large pattern.

In the experiments no attempt was made to reproduce the deck above which the sail would hang. Nor was a jib used. Either of these would have introduced disturbances in the nature of deflections of the air-current, which would have injured the chance of getting accurate results.

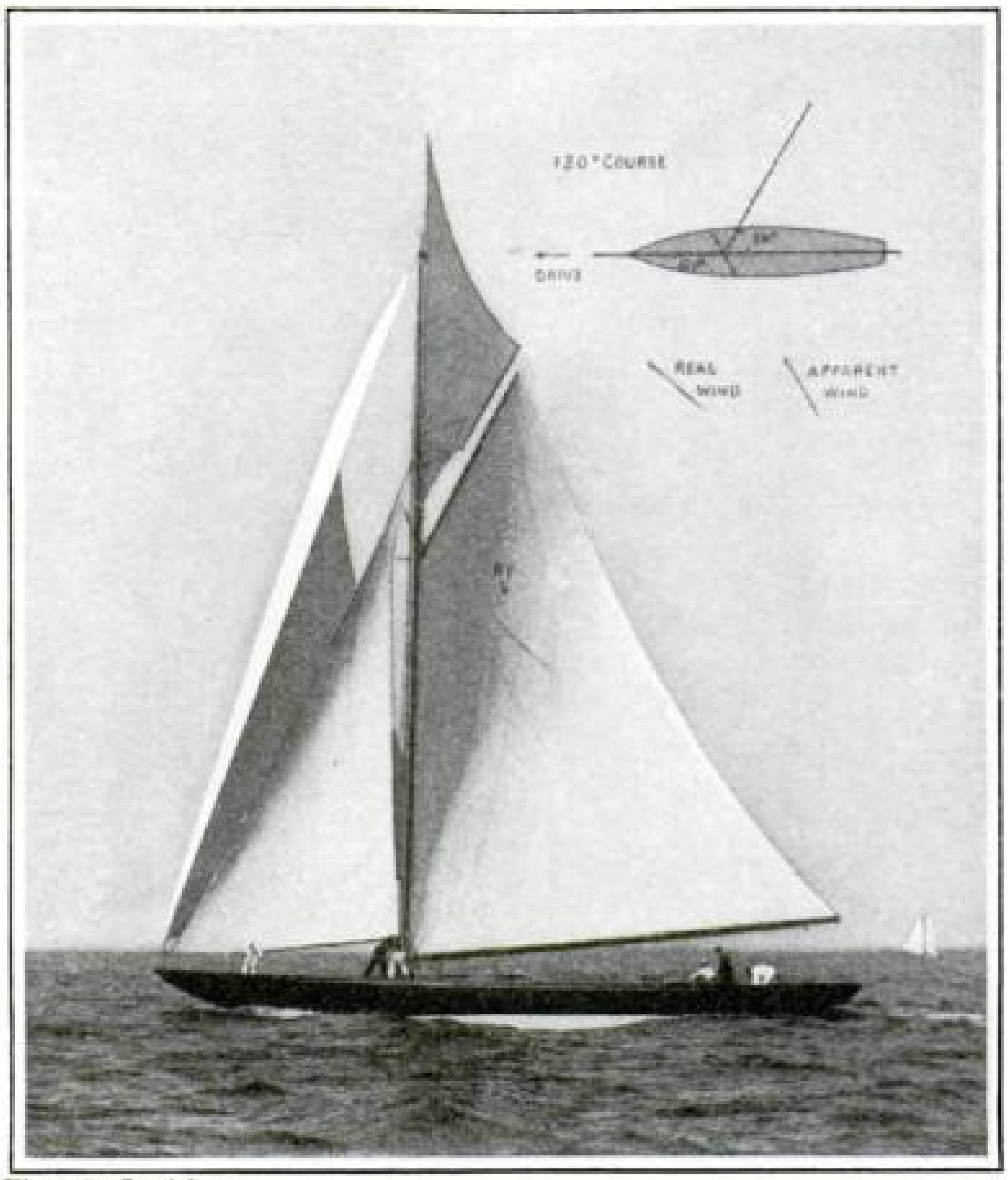


Photo by Levick

Here the distinction between real wind and apparent wind is very close

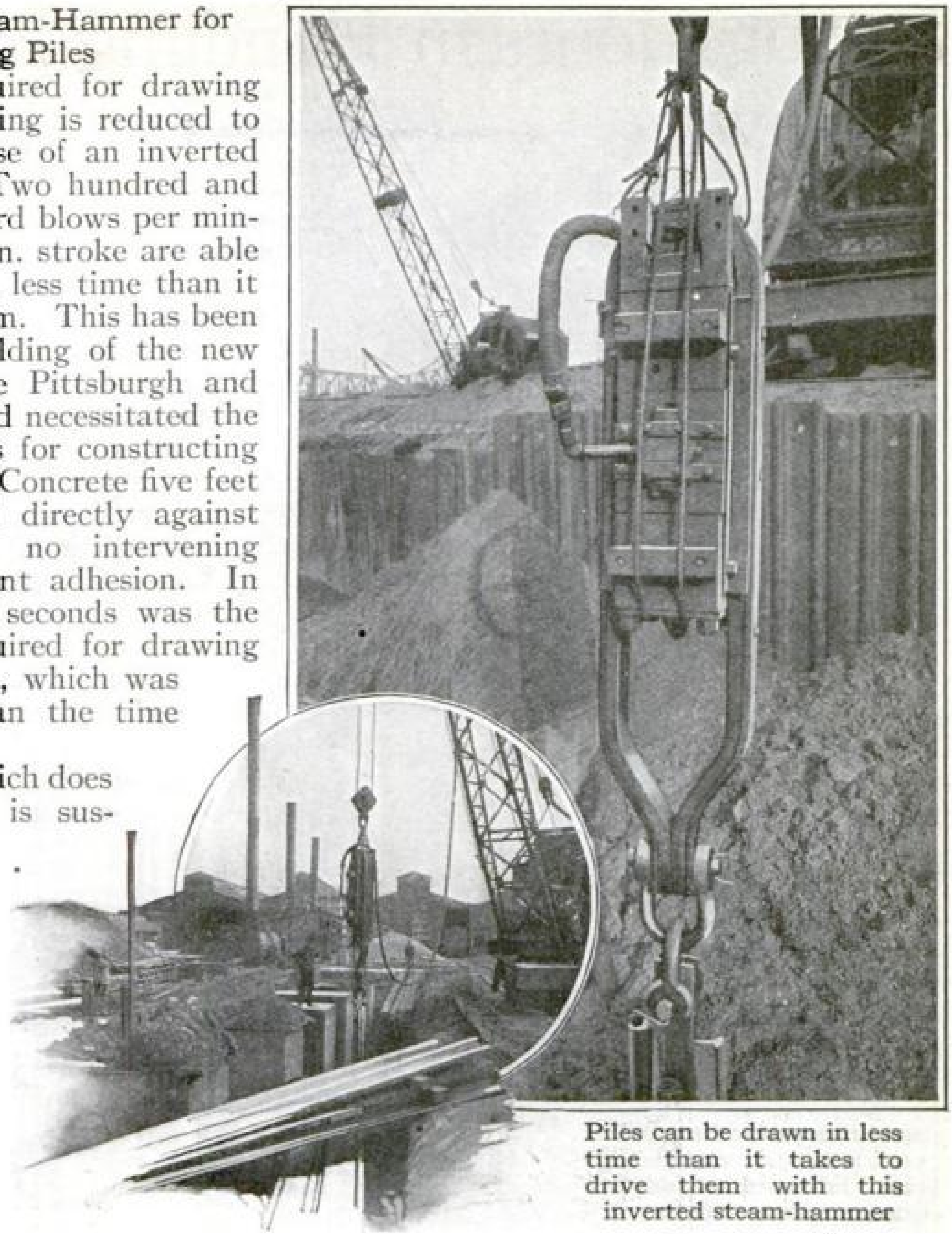
Another variation from natural conditions in sailing was that the boom was fastened to the mast, but the gaff or upper boom was free to swing off into any angle to which the wind drove it. The sail was set by two halyards as on a yacht. It was attached to the boom and gaff by lacings, and the inner edge or luff was held in place against the mast by small brass rings.

In the wind-tunnel of the laboratory the construction is such that uniformly moving currents of air without swirls in them blow against the object tested. The mast with its sail was set up within the tunnel, and the effect of the wind on the sail was measured. The sail was set at different angles to the direction of the currents of air, and measurements were made at each angle.

It was shown that the angle between the boom and center line should be about half the angle between the fly and center line.

An Inverted Steam-Hammer for Drawing Piles

THE time required for drawing sheet steel piling is reduced to seconds by the use of an inverted steam-hammer. Two hundred and seventy-five upward blows per minute, with an 8¾-in. stroke are able to remove piles in less time than it takes to drive them. This has been proved. The building of the new warehouse for the Pittsburgh and Lake Erie Railroad necessitated the use of coffer-dams for constructing the foundations. Concrete five feet thick was poured directly against the piling, with no intervening material to prevent adhesion. In this case, ninety seconds was the average time required for drawing these 35-foot piles, which was a minute less than the time used in driving.



Piles can be drawn in less time than it takes to drive them with this inverted steam-hammer

The hammer which does this rapid work is suspended from the crane by a heavy wire cable. A massive strap of steel passes around the anvil block in the form of a loop, the ends uniting below for attachment to the pile. A rubber tube conveys the supply of steam from the crane.

The inverted hammer was also employed in the construction of the Lexington Avenue subway in New York city, with a great saving of time. Not only is the work hastened, but the piles are kept in good condition, being ready for redriving as soon as pulled.

Six Battleships Go Into Reserve

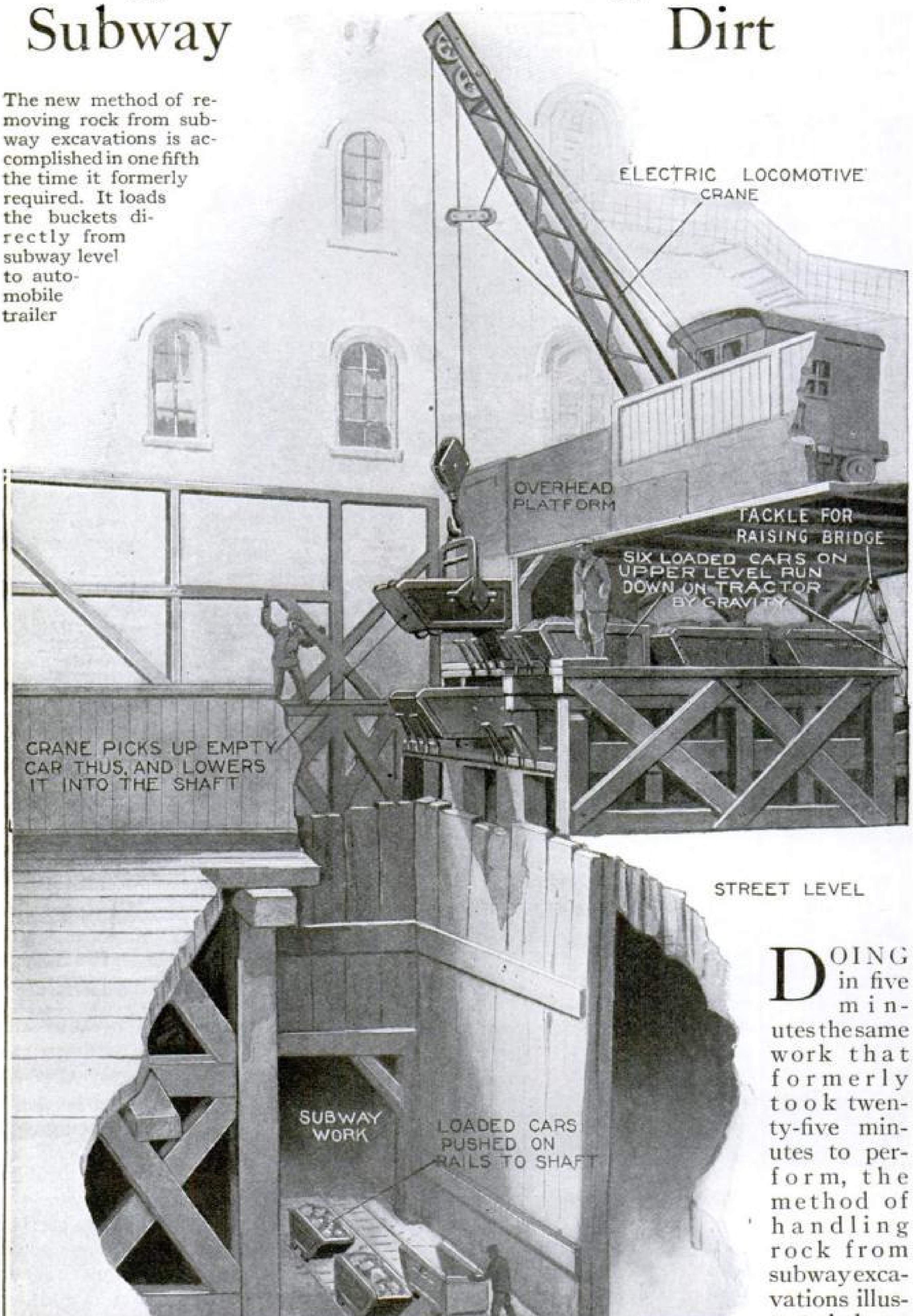
THE navy department announced recently that six of the older battleships of the Atlantic fleet have been ordered into reserve. They are the *Nebraska*, *New Jersey*, *Rhode Island* and *Virginia* at the Boston Navy Yard and the *Louisiana* at the Norfolk Navy Yard. Lack of men was admitted to be the reason for this unusual measure.

When the Fighting Man Dreams

"THE harmony of the sleep of the exhausted soldier has but one discordant note, and that is the dream of battle," declares Dr. George W. Crile. ("A Mechanistic View of War and Peace." The Macmillan Company.) "The dream is always the same, always of the enemy. In the hospital wards, battle nightmares were common, and severely wounded men would often spring out of their beds. An unexpected analogy to this battle nightmare was found in the anesthetic dreams. Precisely the same battle nightmare that occurred in sleep occurred when soldiers were going under or coming out of anesthesia, when they would often struggle valiantly against the enemy's surprise attack."

Saving Hours in Handling New York Subway Dirt

The new method of removing rock from subway excavations is accomplished in one fifth the time it formerly required. It loads the buckets directly from subway level to automobile trailer

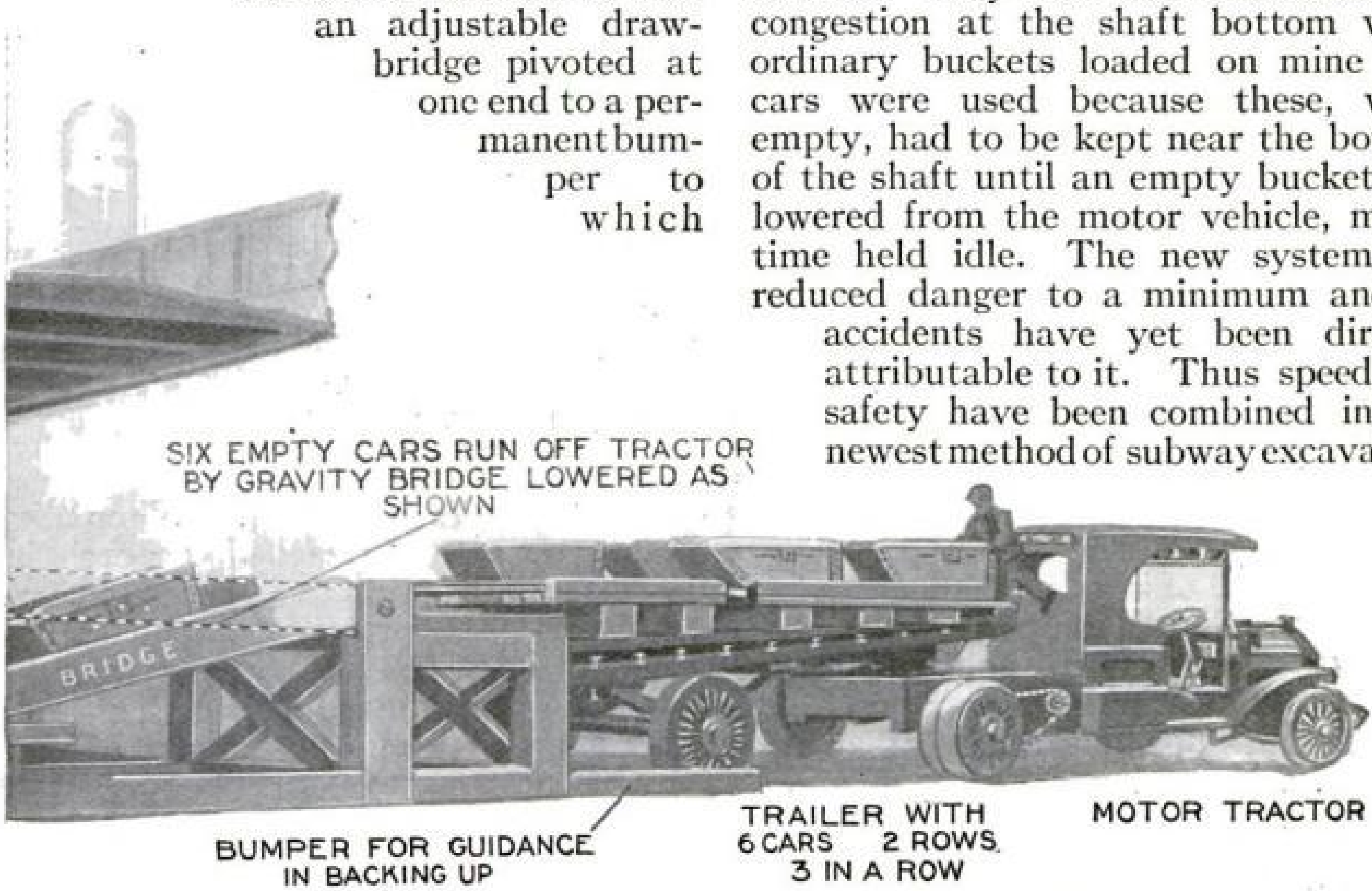


DOING in five minutes the same work that formerly took twenty-five minutes to perform, the method of handling rock from subway excavations illustrated here-

with is one of the most effective systems ever devised. It is in use at three points along the subway route in New York city. It has made possible the employment of huge fifteen-ton motor-tractor and trailer units and has speeded up the entire work of getting the excavated material out of the ground.

The system consists of an elevated platform set up on wooden bents on opposite sides of the street directly adjacent to the shaft leading down into the cut, an electric crane on top of this platform, and a double-decked stand on the street beneath it with an adjustable drawbridge pivoted at one end to a permanent bumper to which the motor-trailers are backed. The buckets used are mounted on wheels. They are loaded in the cut and then moved on tracks to the foot of the shaft where they are picked up by the electric crane and hoisted one at a time and deposited on tracks on top of the double-decked platform. By the time six of the loaded buckets are thus placed, the tractor unit has returned from the dump with its load of six empty buckets, which are carried on tracks on the trailer. After the trailer has been backed up to the bumper, the adjustable drawbridge is tilted from the top of the bumper to the level of the lower platform, and the buckets are rolled down on it by gravity. The free end of the drawbridge is then raised to a level with the top of the double-decked platform and the loaded buckets run down it on tracks on to the trailer, which is then ready to leave for the dump.

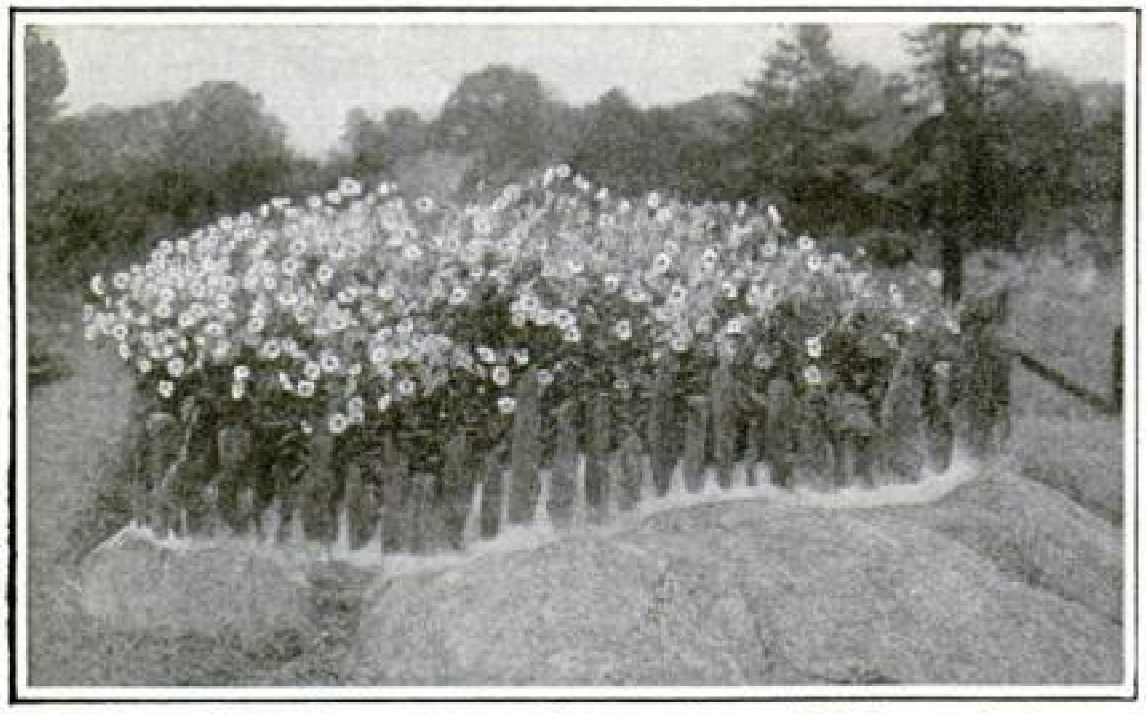
This entire operation takes five minutes. By the old method it took twenty-five minutes. The large saving has been made by having the load ready when the vehicle returns to the platform. The use of buckets with wheels has made possible the quick loading on the surface. They have also eliminated the congestion at the shaft bottom when ordinary buckets loaded on mine flatcars were used because these, when empty, had to be kept near the bottom of the shaft until an empty bucket was lowered from the motor vehicle, meantime held idle. The new system has reduced danger to a minimum and no accidents have yet been directly attributable to it. Thus speed and safety have been combined in this newest method of subway excavation.



Only five minutes are needed to carry the loaded buckets from the cut to an overhead platform and load them on to a motor-truck

A Workshop on Every Farm

ACCORDING to one of the heads of a western agricultural college a source of economy that has been neglected in the past is the upkeep of farm tools and implements. To overcome this depreciation a workshop should be erected. It need not be large, but sufficiently roomy to allow for a workbench, a stove, and a certain amount of floor space where the machinery or tools may be repaired or taken apart and reassembled. This will provide a proper housing for all tools and implements as well as a storage for defective and broken parts.



An ugly rock transformed into a beautiful flower-bed

A Flower-Bed on Top of a Rock

TRANSFORMING the unsightly rocks in your yard into flower-beds is not such a difficult task as one might think. Providing nature has been kind enough to hollow out the top of the rock or make it sufficiently level so you can build a bed of fresh earth on it, all you need to complete the task is a few pointed stones, some cement and the seeds of your favorite flower.

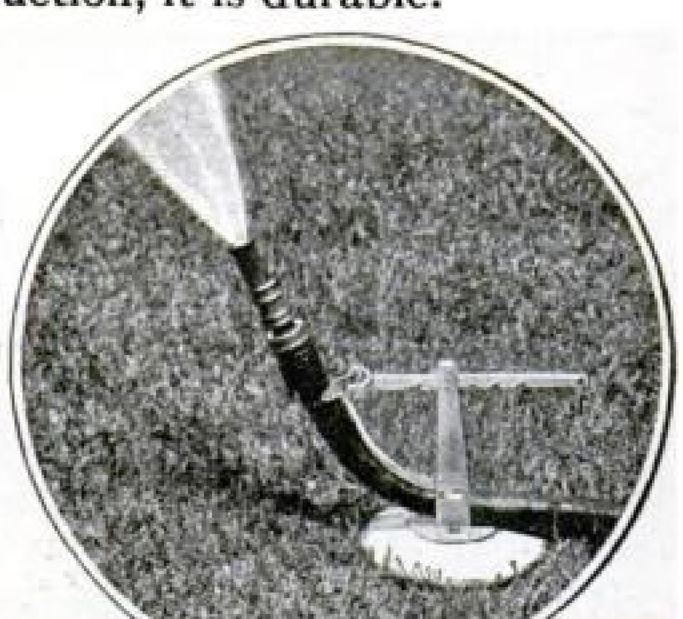
The accompanying photograph shows how one rock was turned into a thing of beauty. Nature had been kind in this instance and the top was hollowed out deep enough to contain all the earth needed. Then the mother and son who thought of the novel plan obtained some cement and pointed stones and enclosed the earth with a miniature picket-fence. Petunias were planted and with constant care, probably with more care than an ordinary flower-bed would need, they grew into a luxuriant lot of flowers. When the petunias lost their beauty rose-bushes were planted and they thrived as their predecessors.

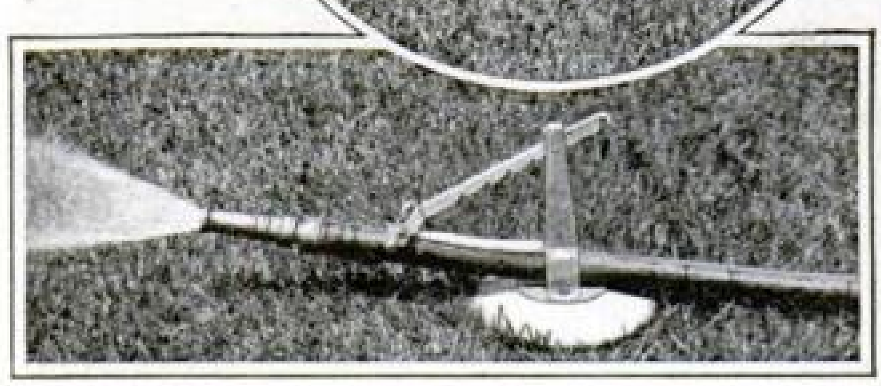
A Unique Garden-Hose Holder

A LITTLE time and work saver in the form of a hose-holding device is shown in the accompanying illustration. Its purpose is to hold the hose, while sprinkling the lawn or flowers, in any desired position, thereby doing away with the tedious process of hand sprinkling. There is a flat, circular metal base out of which rises a sheet-iron standard, having openings at the top and the bottom. Outward from the top of the lower opening in the standard extends a tempered-steel spring, while through the opening at the top is a strip of sheet-iron, along the bottom of which is a series of notches. To the outer end of this strip are fastened the ends of a wire loop, which also runs through the outer end of the spring.

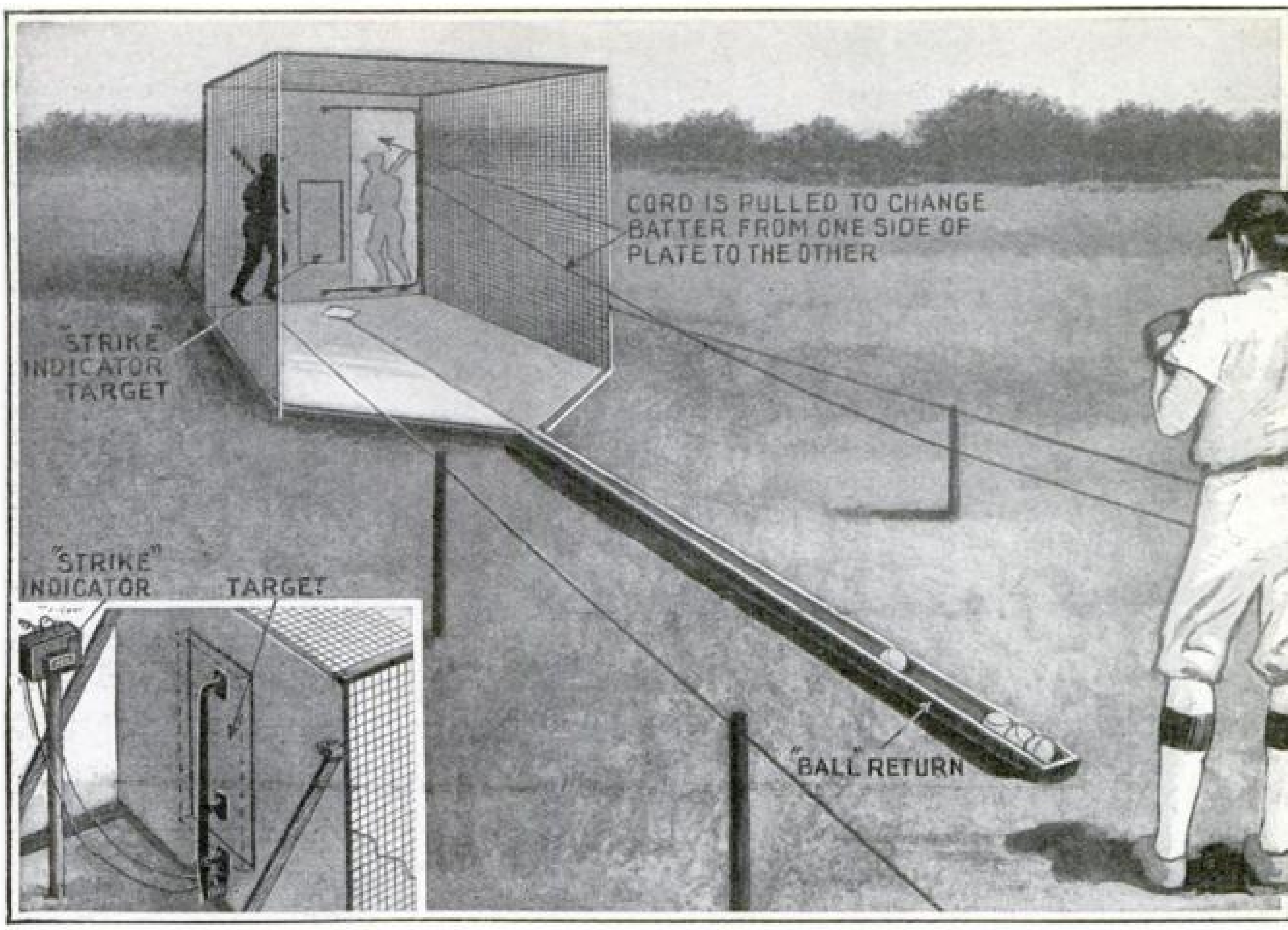
To operate, the nozzle end of the hose is inserted through the opening at the lower end of the standard and is continued on below the spring and through the wire loop at its end. It is then in position shown in the lower picture. To bring the hose to the position shown in the upper illustration, the operator simply grasps the end of the upper notched strip and draws it through the opening in the standard. When the desired position is reached a notch in the strip is dropped over a nail in the standard. The pressure of the spring serves to keep the adjustment securely notched. This device is practical and, being made entirely of metal and of simple construction, it is durable.

The hose is held rigidly in position and will not move under the stress of ordinary pressure





A single adjustment for holding a hose in any desired position



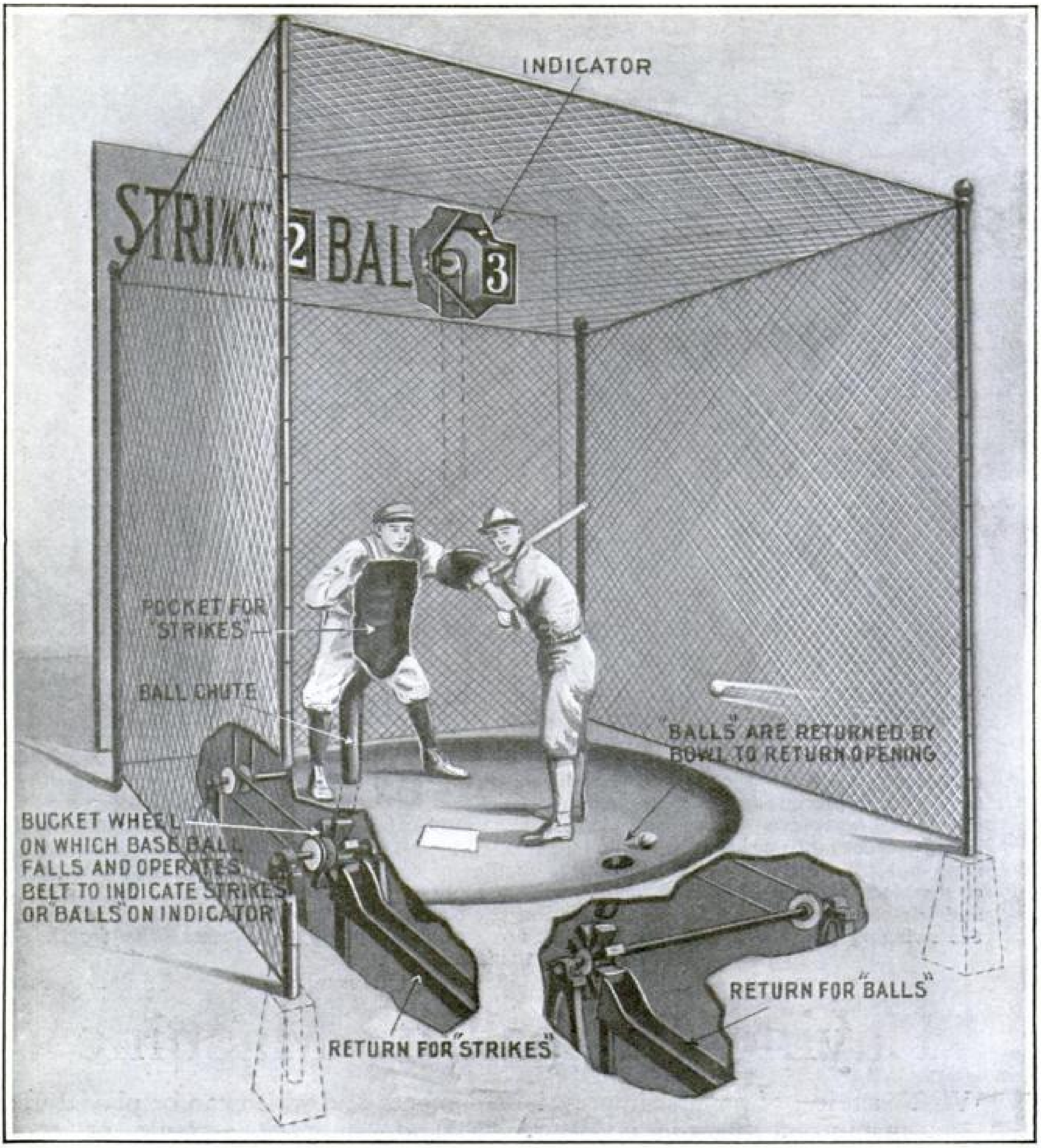
"The automatic umpire," as the inventor of this contrivance for training pitchers has christened it, has a target the exact size of the "strike" area. If the pitcher makes a "strike," the target is driven back a little—enough, as shown in the insert, to complete an electric circuit and operate a "strike" indicator. If the pitcher fails to hit the target, the indicator is not operated. In either case the ball is returned by a trough. Black silhouettes of batters are painted on either side of the target. Either of them can be concealed by pulling a cord which operates a swinging panel. Thus the pitcher is trained to cope with both right and left-handed batters. In the illustration the concealed batter is shown faintly behind the swinging panel, although the figure is not actually seen by the pitcher—this for the sake of making the invention clearer

Playing Baseball by Machine

EVERY subject of popular interest is an inspiration for the inventor. It is, therefore, natural to expect that baseball would spur the man of wheels and springs, cogs, levers and gears, to many efforts, resulting in a large number of inventions relating to the Great American Game.

Outside of those which relate specifically to the sport as practiced—patents on balls, gloves, protectors, masks, spikes, bags, marking apparatus and similar things, mechanical baseball inventions divide themselves roughly into three classes. These are—games which simulate the great game itself, and which are supposed to provide at least a modicum of the thrills of the real diamond, and which can be played upon lawn or in parlor—games or sports based on baseball which are suitable for country fairs, circuses, midways and similar places, in which the public participates either as batter or as pitcher, and finally, inventions designed to aid in the actual training of ball players, by making their practice easy, or providing them with mechanism by which they can tell when their practice approaches perfection.

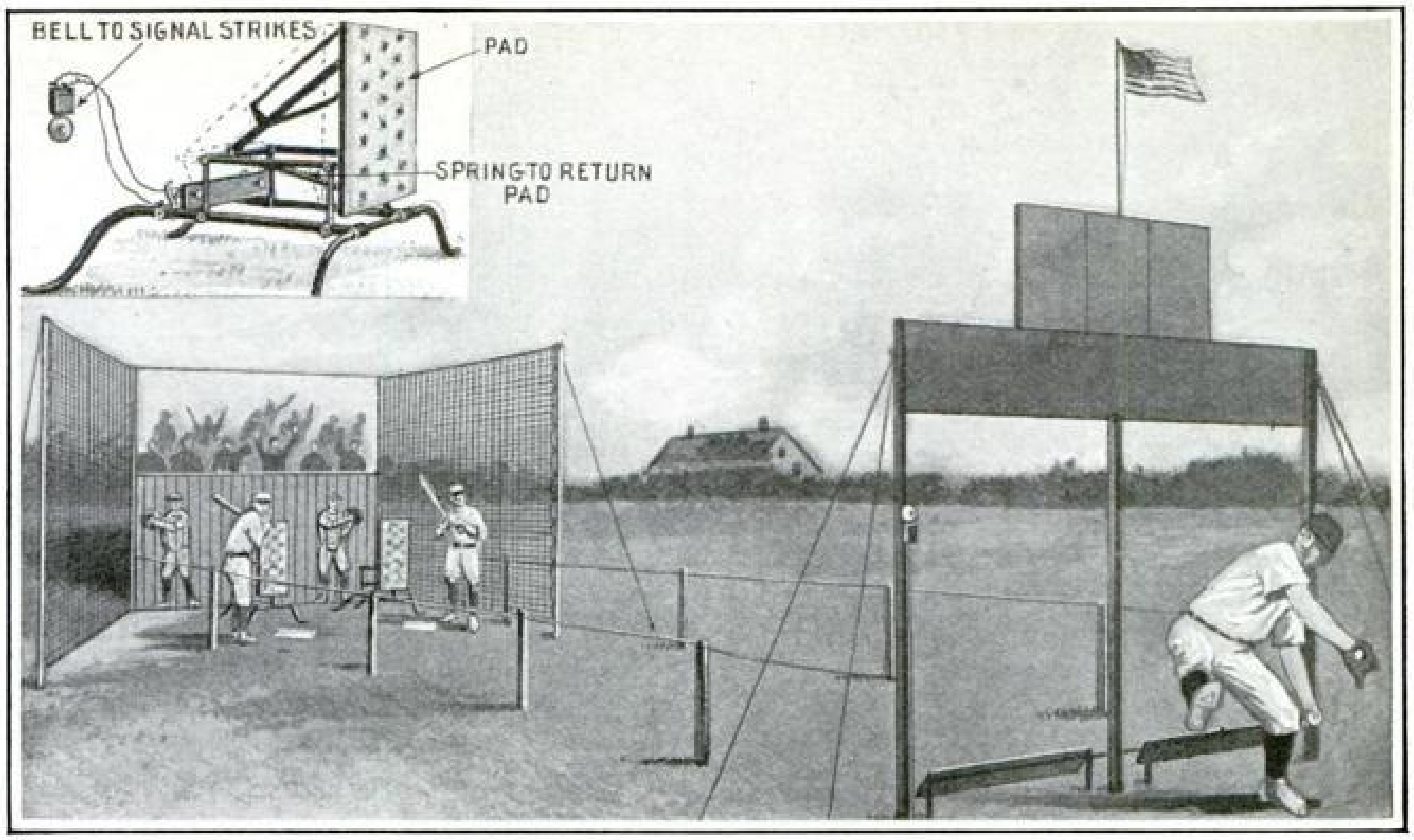
Considerable ingenuity is displayed in several such patented games in the construction of a "pitcher" which (should one say "who?") delivers the little rubber ball at various speeds and angles.



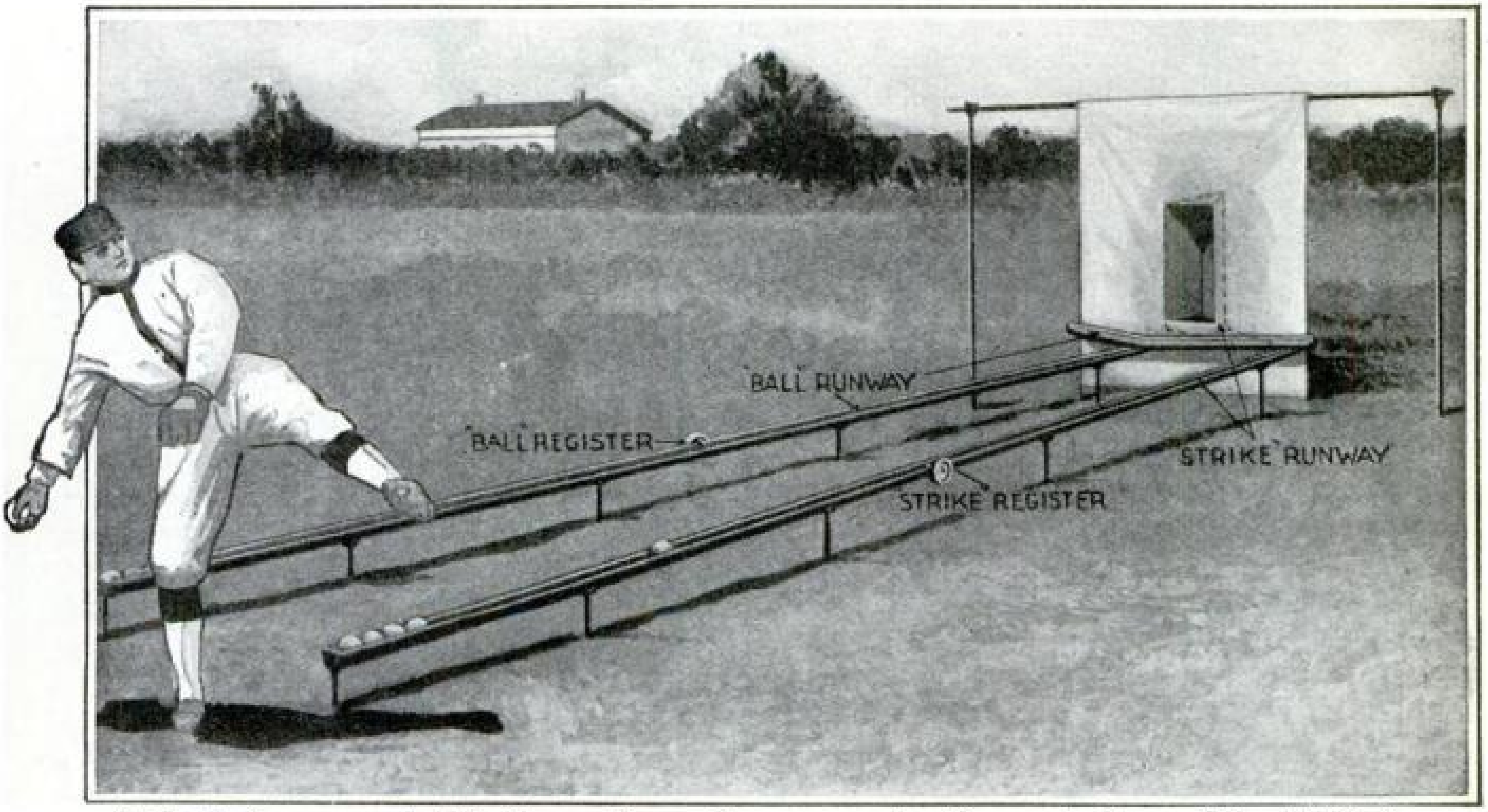
This apparatus for teaching the art of pitching a baseball provides for everything except derisive howls from the bleachers. Both the batter and the catcher are dummies. The catcher-dummy has a cavity for receiving pitched balls, the entrance to which corresponds with the area for a "strike." Above is an indicator for "strikes" and an indicator for "balls." When the pitcher throws a ball over the home plate at the right height, it enters the cavity in the dummy-catcher, drops down a chute and hits the blade of a bucket-wheel. Since the bucket-wheel is connected by belts with the indicator above, the pitcher sees his "strike" recorded. The ball is ultimately sent back to him by a return trough. If the pitcher fails to make a "strike," the ball drops into a bowl in which both the batter and catcher stand. The ball rolls into an opening and falls upon a bucket-wheel, connected by belts with a "ball" indicator. A special trough is provided for the return of the ball

But such games, no matter how ingenious and interesting to those who love baseball for itself, are tame sport for the active and are really only for the sedentary. Much larger and more intricate mechanisms are invented, patented, and operated at country fairs, where the spectator becomes an actual player and pitches against an automatic umpire.

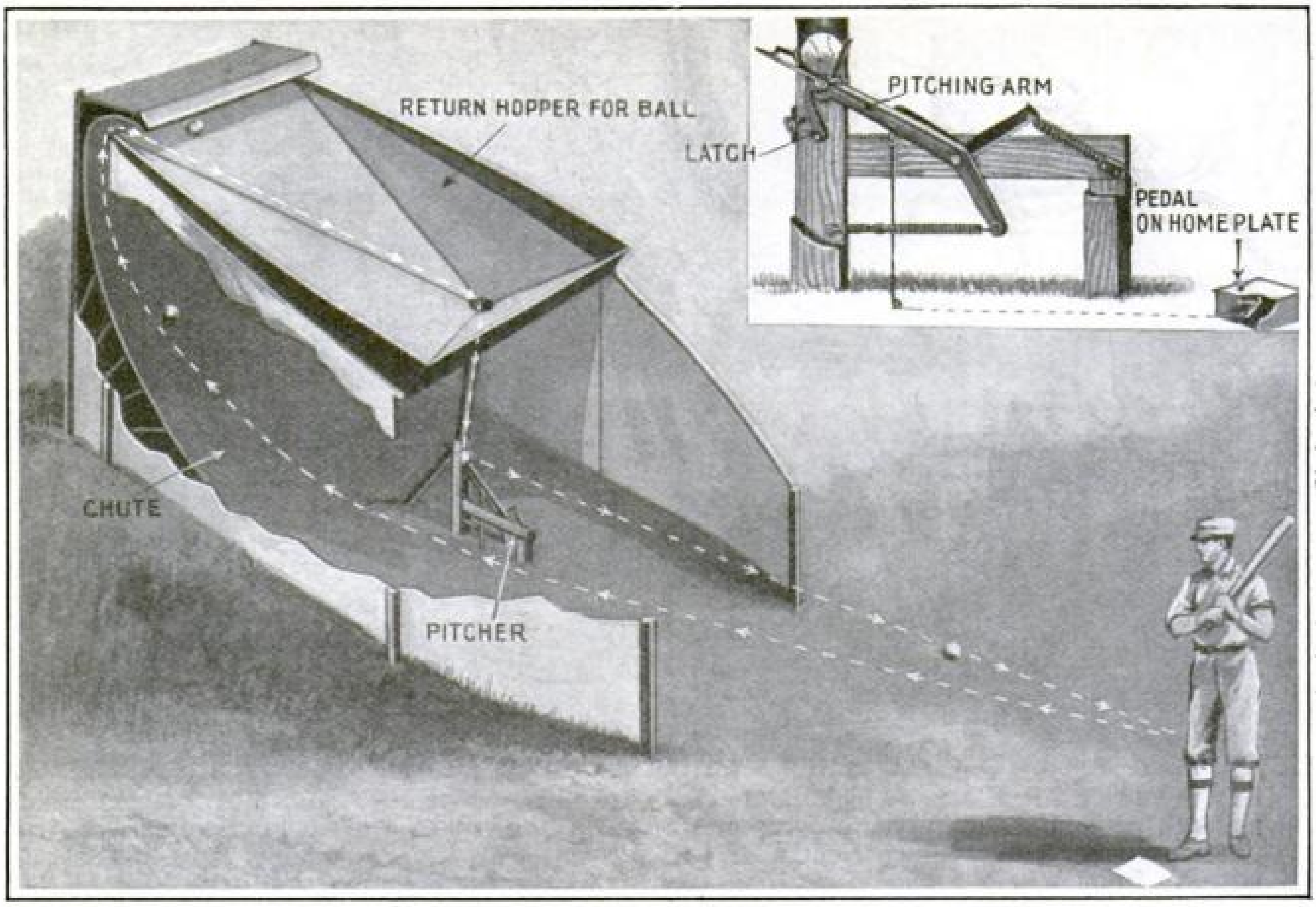
The "automatic umpire" is usually some form of opening in a background.



At the end of a lane formed by rope fences is a wall on which the figures of catchers are painted, as well as enthusiastic occupants of grandstand seats. Two home plates are provided—one for a dummy left-handed batter and the other for a dummy right-handed batter. Immediately behind each home plate is a pad, corresponding with the "strike" area. When the pitcher makes a "strike," the pad moves back, completes an electric circuit, and rings a bell. A spring returns the pad to position, whereupon the bell ceases its ringing and the apparatus is ready for the next pitched ball



A sheet of canvas, stretched on a frame, has an opening the exact shape of the "strike" area to be considered by the pitcher. Back of the opening is a pocket communicating with a trough behind the sheet, leading to the "strike" runway shown. A second trough extends across the front of the sheet and communicates with the "ball" runway shown. Pitch a ball so that it passes into the opening in the canvas and you make a "strike," the ball being returned in its special runway after recording the "strike" on a register in the runway. Pitch a "ball," which means that you fail to land in the opening, and the ball will also be returned by way of the "ball" runway, your inaccuracy being subsequently registered by another recorder



The mechanical batting instructor not only pitches the ball but returns it to the pitching-machine. You simply bat and bat and bat until your arms ache. The ball is sent up an inclined plane, which has a reverse curve at the top, so that the ball finds its way into a hopper and into a funnel leading to a pitching-machine. The insert shows how the pitching-machine works. The ball drops on the upper end of a pitching-arm. As it does so it releases a latch by which the pitching-arm is held against the tension of powerful springs. Suddenly freed, the pitching-arm hurls the ball at the waiting batter. On the home plate is a pedal connected with the pitching-arm. By pressing the pedal with his foot the batter can reset the pitching-arm as fast as he wishes

As one inventor plans it, the chest-protector of the figure of a catcher in lifelike attitude is made as an opening of such size and shape as will accurately represent the plane in space, of which the width is that of the plate and the height the distance between knee and shoulder, through which, according to the rules, a pitched ball must pass in order to be a "strike."

Far more interesting, however, to the average visitor to a country fair is the type of device in which he takes bat in hand and stands in a batting cage, to try his skill with the ash against a mechanical pitcher which actually pitches real baseballs. He does this fearlessly enough; for it is the one great advantage of the pitching-machine that it is never "wild" and never, therefore, at all apt to "bean" the batter (hit him on the head). Some of these mechanical pitchers are but spring-guns designed to fire baseballs at the batter. Others have a figure in front of the gun-barrel which raises its arm, goes through a "wind-up" and makes a throwing motion coincident with the actual delivery of the ball.

To still further extend the illusion and make of the practice of batting a "game," a "mechanical ball field" at a reasonable distance from the batter is sometimes provided. Here a numerous crop of targets appear in serried ranks and various heights. Any one of these targets, hit with a batted ball, registers in a convenient place the "value" of the batted ball. It may be a one, two or three-base hit, a "home run," "grounder," "fly-ball" or what not.

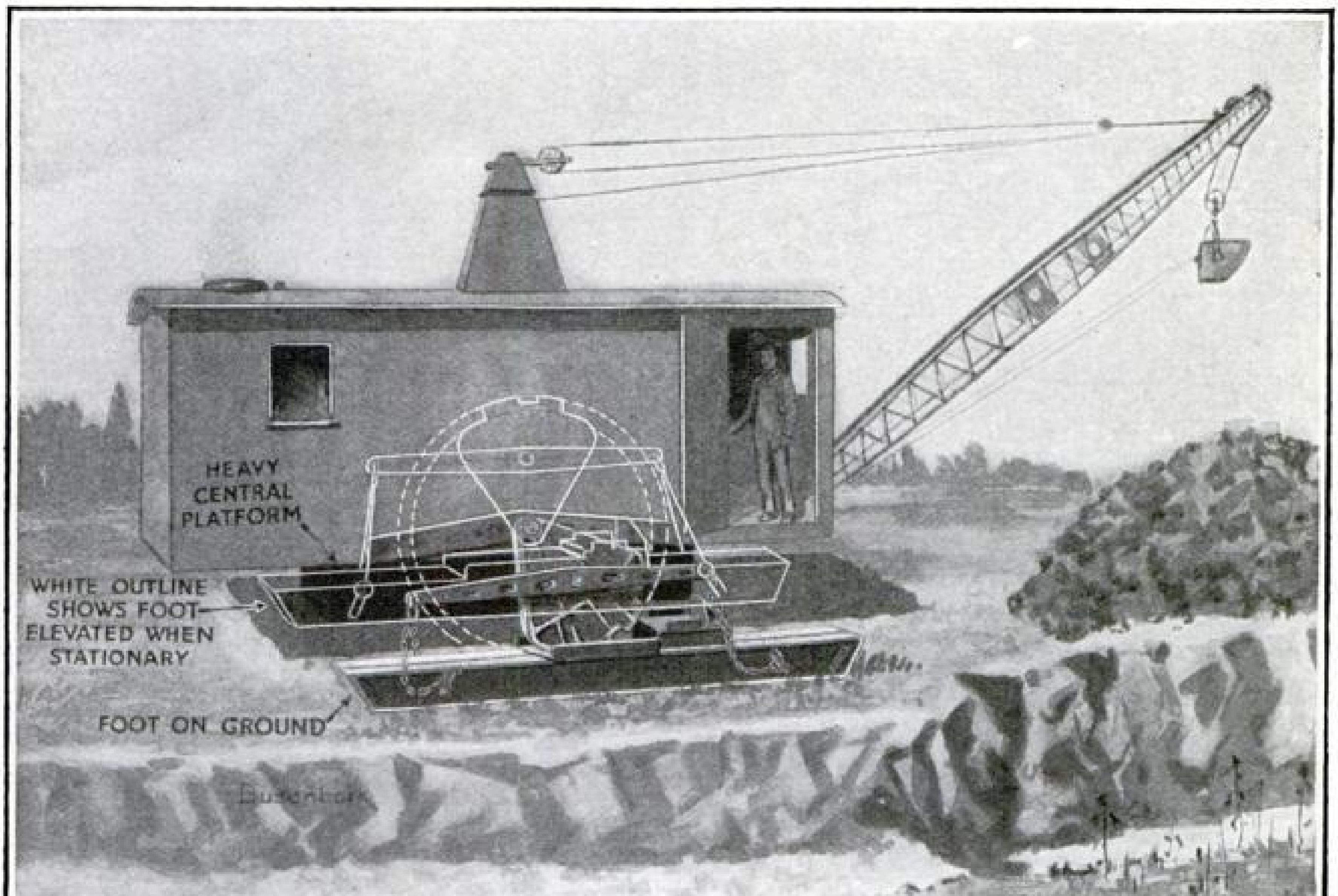
Of the devices actually used by baseball players to train themselves in the art of playing the game, the pitching-machine would seem the most common. The "automatic umpire," however, seems to have some claims to real use.

An Excavator Which Walks

A BIG excavating machine which literally walks to its job is being used by the United States Government on one of the great irrigation projects of the Southwest, and the advantages of this pedestrian accomplishment are many. Most of the machines of this character are built to roll over the ground on wheels, but its movements are necessarily limited, for it dare go only where the ground has been carefully prepared for it. Unless the path is most favorable, planks must be carried ahead and laid for it to move over. Otherwise the wheels would tear up the road and such a thing as making a short cut across the country would be out of the question, for it would soon be hopelessly stalled and its extrication only made possible by removing it piecemeal. In fact, this is the way in which these machines are generally transported from one job to another. They are taken apart and transported in convenient parts and reassembled at the new point in the field of operations.

This perambulating excavator will "walk" along the road without any regard to the character of its structure and not leave a footprint behind; and furthermore, if the road does not happen to be the shortest route, the machine will walk across country over soft ground which will barely hold a man. If a house, tree, or hill happens to be in the way this machine will walk around it, covering the ground at the rate of twenty-five or thirty feet a minute, a very respectable speed for such a lumbering sprinter.

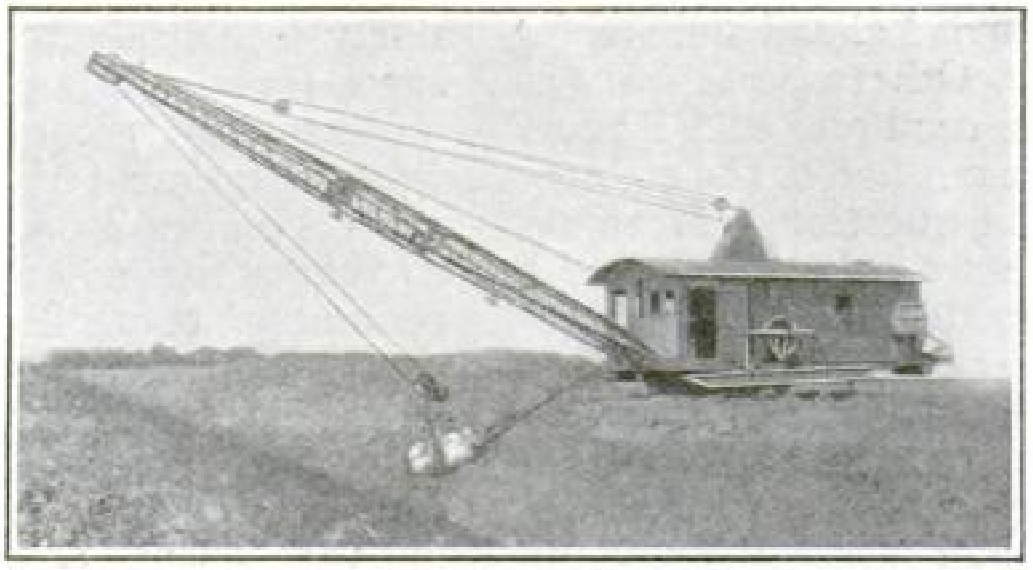
When the digger is at its regular work of excavating, it rests on a heavy central platform on which it is revolved so that activities of the bucket may be accurately controlled. When it is desired to have the machine move, the engine is connected with a driving-shaft extending across the width of the excavator. On each end of this, outside of the house of the operator, are



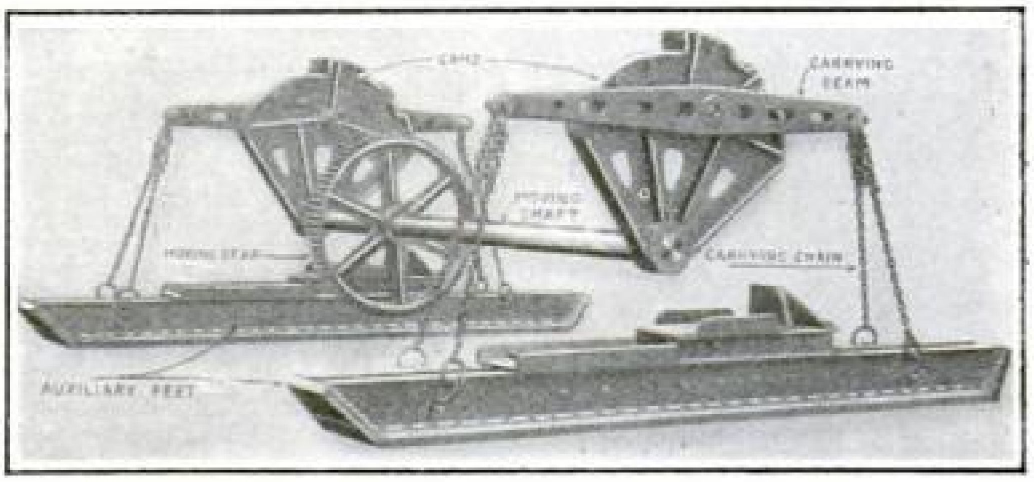
Two footlike pieces are suspended beneath the cams on either side of the driving-shaft. In moving, the feet are lifted and lowered alternately, producing a steady, deliberate walk. To change the course of the machine, it is turned when resting on the central revolving platform

mounted two large cams. Directly under each of these there is suspended a foot. As the shaft revolves, these feet are lifted by the chains which are suspended from a carrying beam attached to the cams and drawn forward and dropped on the ground, whereupon the cam comes in contact with them and its toothed surface engages with similar depressions on the foot. The whole machine is raised and moved forward and gently placed on the ground again, the motion suggesting nothing more than a deliberate walk. It is said that this additional apparatus represents no more weight than the skids, planks and other paraphernalia made use of in the movement of other excavating machines when shifting location.

In this manner the machine will follow a straight line. When it is necessary to change its course for any reason, the walking apparatus is stopped at a point when the combined weight is resting on the revolving platform under the center of the machine. By making use of the latter the machine is headed in the desired direction, after which it will proceed along its new course as long as desired. When engaged in trench work, which is of a progressive character, the machine "walks" along as the work on the trench is completed. This is a great advantage in the reclamation service in which these machines are employed by the Government instead of mule teams, which have been eliminated by machinery.



This excavator is being used with success by the United States Government on one of the great irrigation projects of the arid Southwest



The driving-shaft, the huge cams and the feet suspended by chains from the bars on the cams are shown in their relative positions in the picture appearing to the right

Nations Bleed in Peace as Well as in War

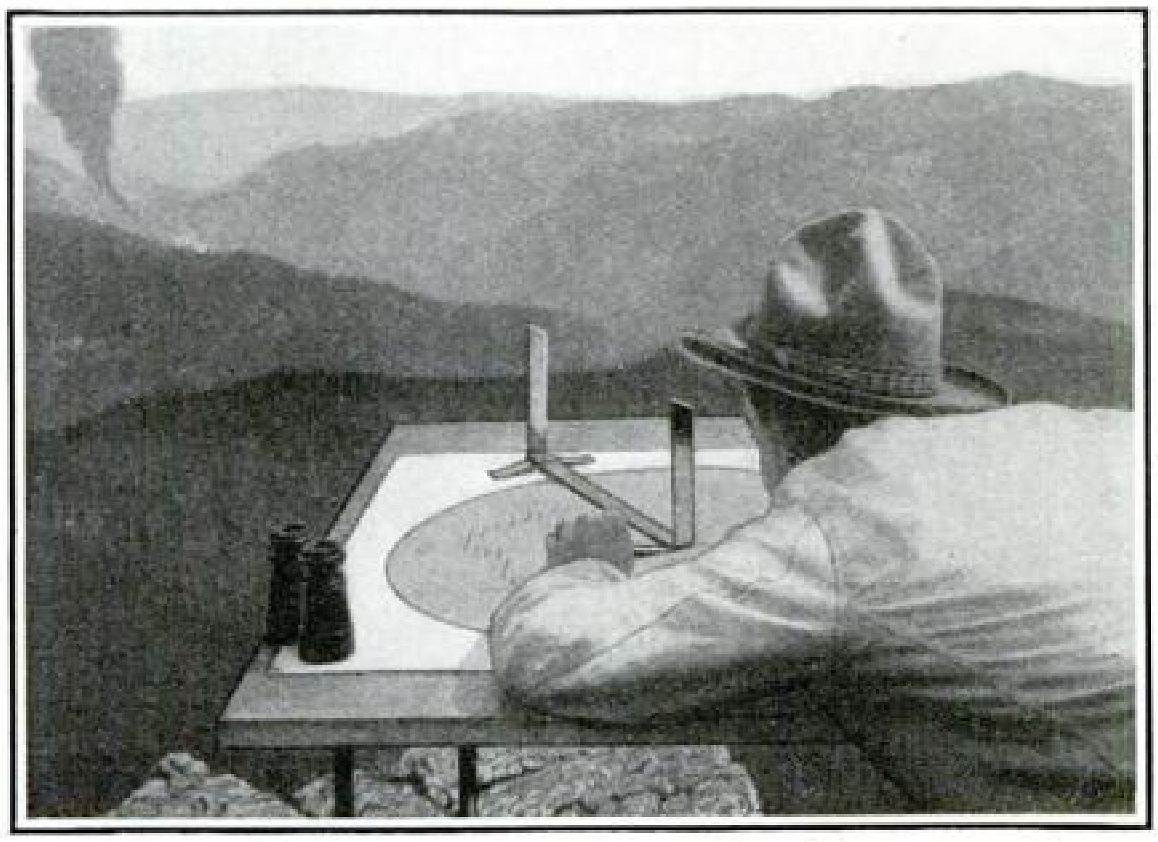
CANADA is awakening to the fact that while she is bleeding openly in war she has been bleeding quite copiously in time of peace. In other words, a comparison of the industrial accidents and casualties with a list of the casualties of the Canadian Forces at the front, reveals the information that certain arts are as destructive, in proportion, as certain forms of warfare. Furthermore, Canada believes that she has opened her heart and administered with every effort to those crippled in the war, but has given little attention to those crippled in the arts of peace, except to pay them a small indemnity.

Despite the fact that improved machinery has been installed in most Canadian plants, cutting down appreciably accidents formerly due to old operating methods, the number of accidents has continued to keep up. For instance, Prof. F. H. Sexton of the Technical Department of the University of Nova Scotia, at Halifax, has kept a careful record of killed or injured workmen in the industrial arts. Comparing his statistics for, say, December, 1914, with the same month for 1915, one finds that fifty-five men were killed as against fifty-six of the year before, while two hundred and sixty-eight were injured as against two hundred and seventeen of the previous year.

Fighting Timber Fires

BATTLES against timber fires in the great national forests of the West are conducted with a degree of precision and strategy rivaling that of the warring armies of Europe, as the result of systematic operations of the United States Forest Service. A forest supervisor who may be many miles from the scene of a fire marshals his forces and fire-fighting facilities and directs the attacks and flank movements of his men.

Lookouts stationed on mountain peaks and other promontories that command a wide range of vision are each supplied with a plane table to which is attached a map of the surrounding country, its position being determined by means of a compass. The map is enclosed in a segmented circle and the location of the station is indicated by a pin. A simple alidade (an alidade is the upper part of a surveyor's theodolite) consisting of a ruler with uprights for sighting purposes at either end, or some similar device, is included in the equipment.

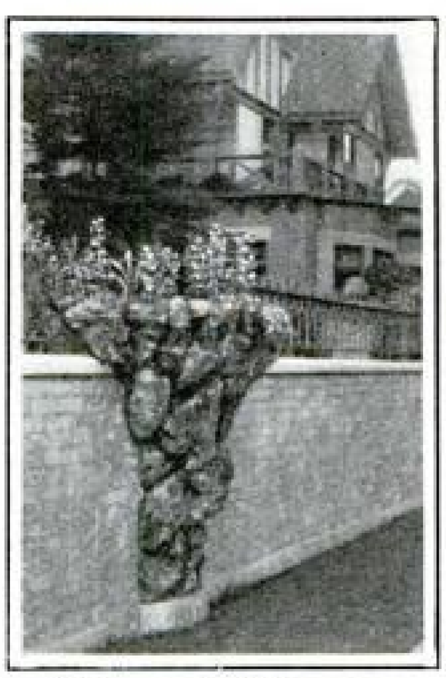


A timber fire in our western forests has about as much chance as a spy who is being watched

When a lookout sees smoke issuing from a portion of the forest over which his station commands a view, he immediately sights it with his alidade and notes that it is coming from a point so many degrees east or west of a north and south line extending through his station. He notifies his supervisor by telephone, telling him of the apparent size of the fire and its location. Lookouts in other sections of the forest also detect the fire and make similar reports to the supervisor's headquarters. Reports from two or more stations enable the supervisor to locate the fire on a map by means of intersecting lines.

Conelike Flower-Holder in a Brick Wall

NOWHERE is novelty more desirable than in the flower-holder line. This is what a resident of Los Angeles, California, thought when he constructed the novel fence flower-holder shown in the accompanying illustration. In this fence there are three sections, these being connected by six-foot "steps." In the center of each of these sections one of the flower-holders is located.



Flower-holder in a brick wall

Each of these containers is about three and a half feet in height and about a yard in diameter at the top. Each holder is in the form of a cone, being large at the top and becoming gradually smaller as it continues downward. While the fence within which it is located is made of pressed brick, the holder is made of brick of a clinker variety, being a trifle darker than the fence brick and harmonizing effectively with it in both color and design.

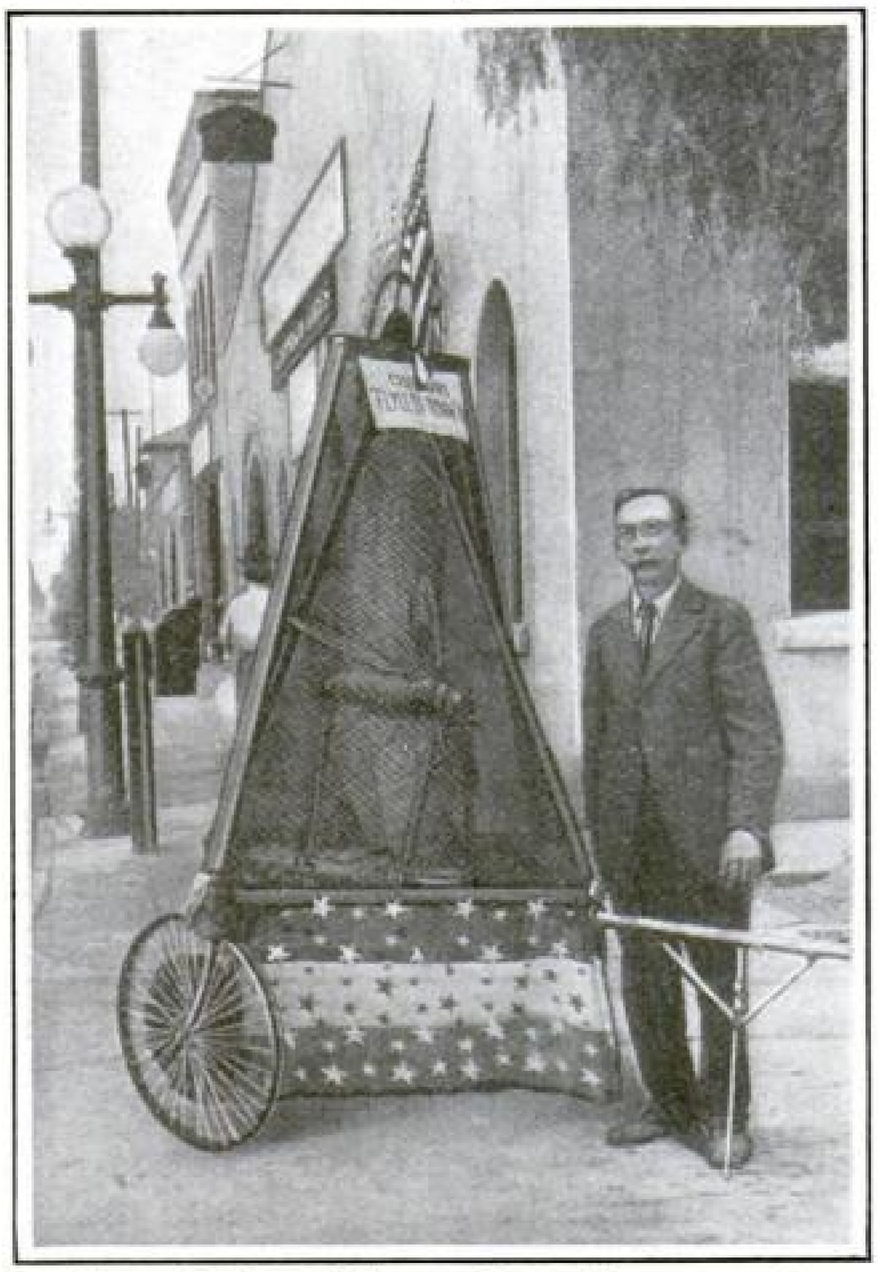
Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

The Official City Fly-Catcher of Redlands, California

WHEN A. E. Chapman, an inventor, offered his first patent fly-trap for sale in Redlands, California, he did not have the least idea that he was taking the first step in creating a new city office, the only one of the kind in the entire country.

With the invention of his new death-trap for flies came the new official position of city fly-catcher. Chapman, the inventor, was appointed at a salary of $10 a week, the office being in existence nine months each year. Chapman began work by placing scores of traps at street intersections, around restaurants, and in the rear of livery-stables.

The bait placed in the traps was fresh canned fruit, syrup, sugared water, sprinkled with cinnamon, watermelon, or fresh meats. The flies crowded into the cages—and to their deaths.


A professional fly-catcher who exterminates millions of flies each year

The carcasses of the flies are removed each morning by the official fly-catcher. He decided that he would estimate their number by enumerating them in units of liquid measure. During the first year between two hundred and forty and two hundred and forty-five gallons were gathered, on the basis of fifty thousand to seventy-five thousand carcasses to the gallon. Taking an average of sixty thousand to the gallon, between 14,400,000 and 14,700,000 were coaxed to their deaths in a year.

Mr. Chapman built a "jumbo" trap, which he had in a "Made in Redlands" day parade, inside of which are two small traps and a monster home-made fly.

The Five-Wheeled Velocipede

A SMALL boy who was clever at designing mechanical novelties produced a five-wheel velocipede tandem from the parts of two machines.

One of the velocipedes met with an accident which put its front wheel out of use beyond repair. The other machine was sound, however, and the problem was how to construct a vehicle which would permit both the boys to ride.


The loss of a velocipede's front wheel suggested this combination of two machines

The connection between the front fork of each machine was loosened, the bolts removed with a monkey-wrench and the connection made again with the rear of each velocipede turned upside down. This made it necessary to remove the saddles, and they were placed on the rear forks close to the rear axle. Then the problem was how to connect the two machines to form a tandem. It was accomplished by removing the rear axle of the leading machine and slipping it through the openings in the front fork of machine number two. The axle was then replaced and the wheels bolted on.

The Marvelous Voice Typewriter

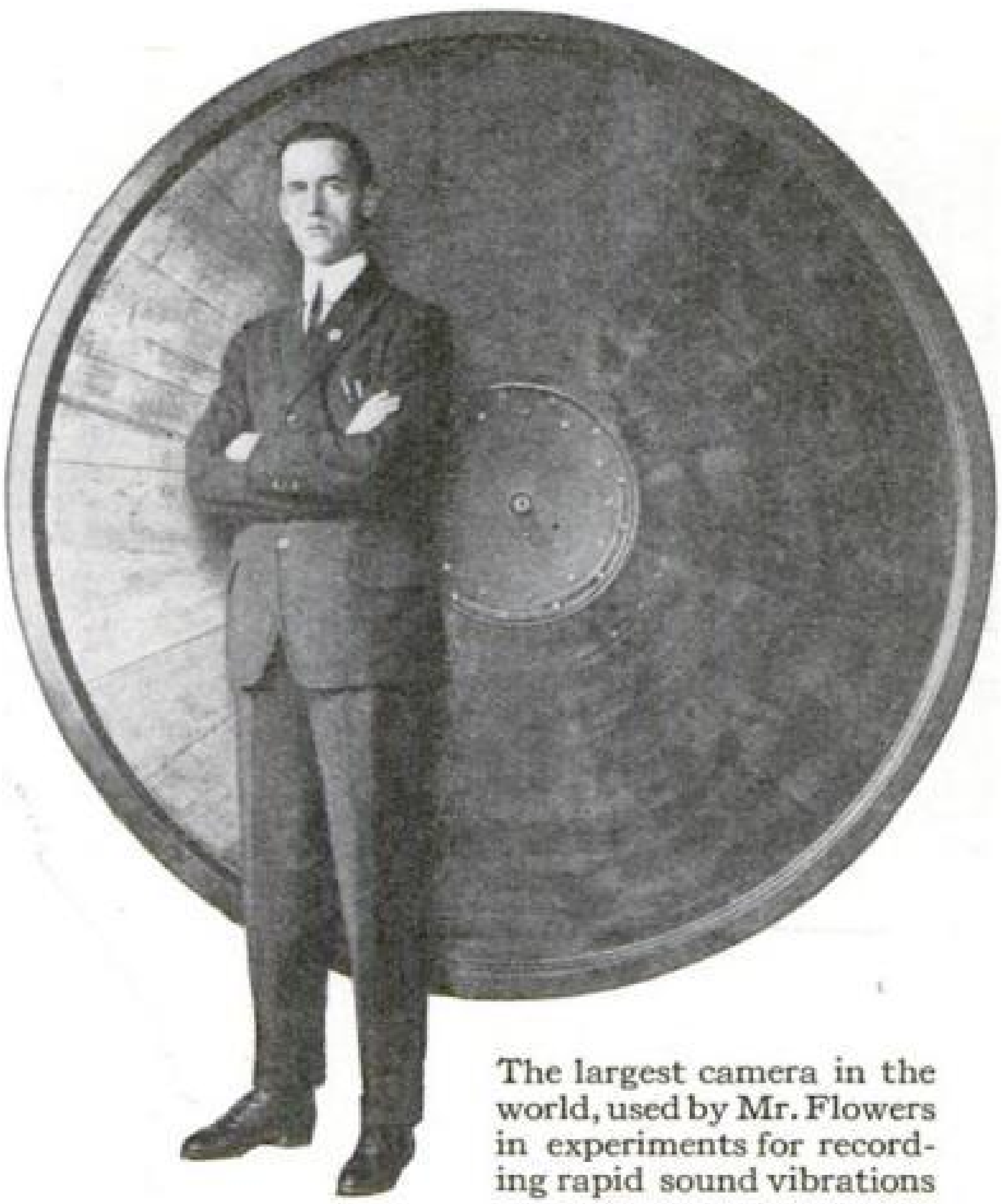
Talk to It and It Writes

By Lloyd Darling

CONCEIVE an ordinary machine resembling the machines in common office use—full of the customary cog-wheels and crooked levers and variegated springs. It might be an adding machine so far as one can judge by external appearances or a dictaphone or a new-fangled cash-register. But——

Speak to it!

It becomes alive. It *hears* you. It vibrates with action. Somewhere inside, typewriter bars go "clickety-click-click." At the top of the machine a sheet of paper unwinds from a roller.



The largest camera in the world, used by Mr. Flowers in experiments for recording rapid sound vibrations

The machine has written down what you have spoken!

If you said "cat" it wrote down "cat". If you said "Dear Sir: Your favor of recent date received and——," as though you were starting out an ordinary, time-worn business letter, it wrote that same thing down.

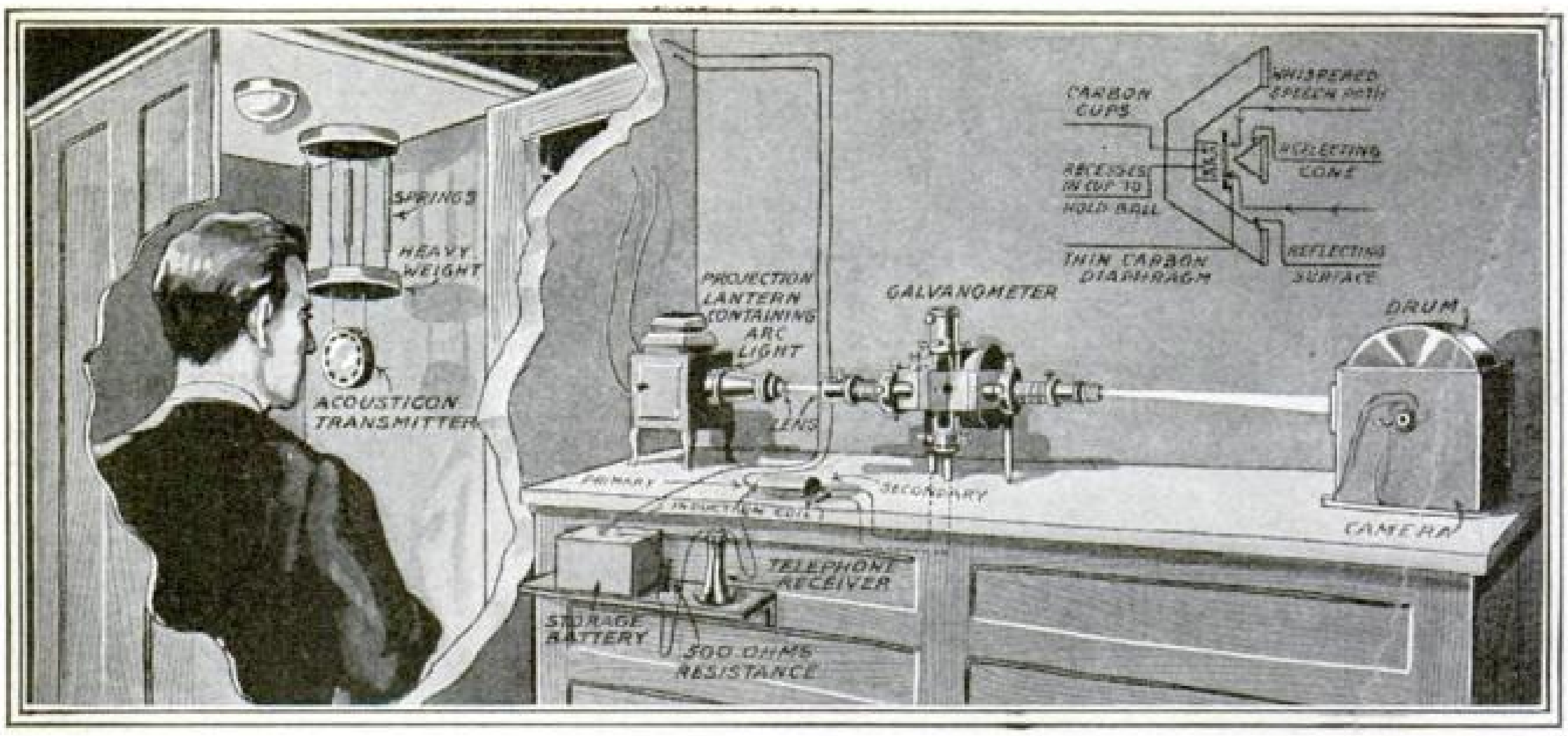
An odd feature about the machine is that it spells words as they sound and not according to some fat dictionary. Indeed it would have to be a phonetic speller. How else could it distinguish "dough" and "tough?" But if you are considerate, and mindful of its feelings enough to spell out words correctly in cases where it might be likely to err, the machine will very obediently follow you and make the resultant letter strictly orthodox so far as spelling is concerned. It faithfully tries to do its best.

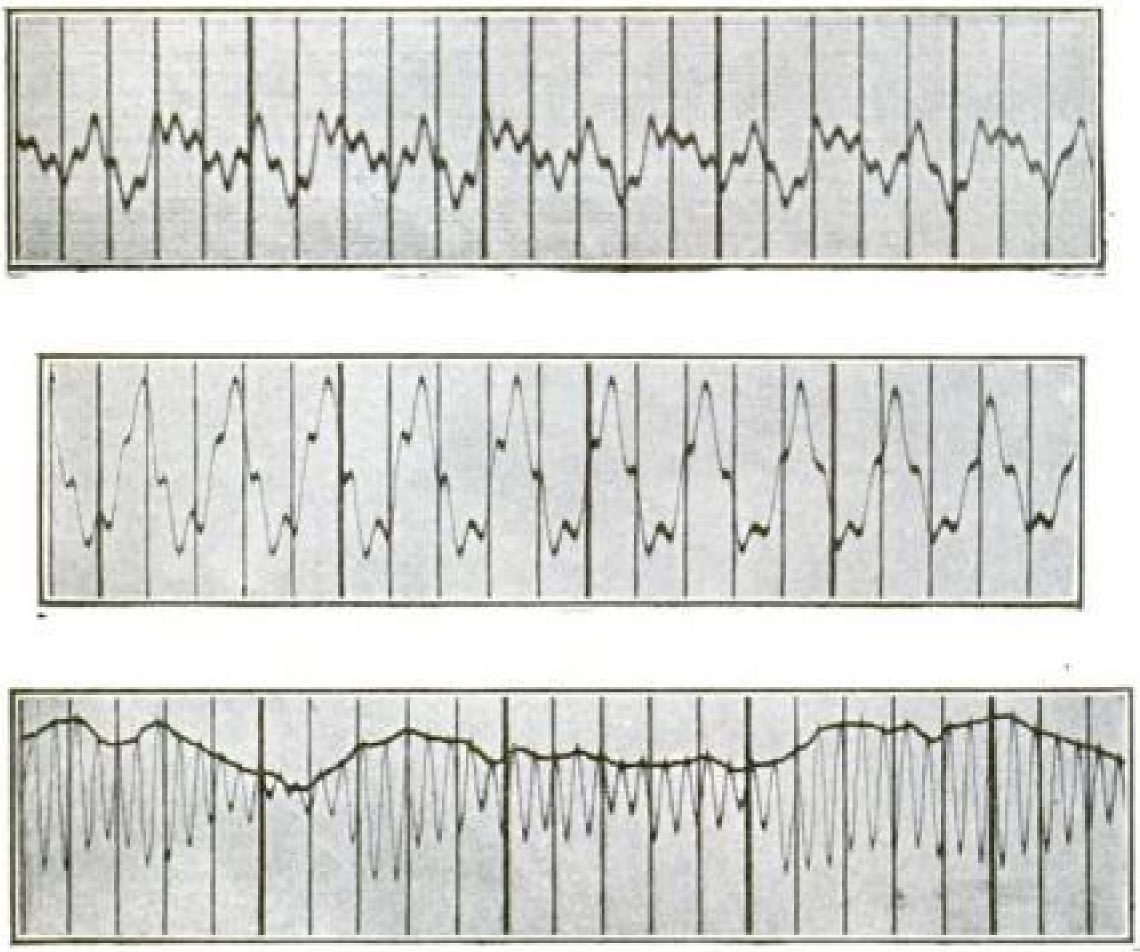
Does the machine think, as well as hear? How else can it perform all these feats if it doesn't reason?

Unfortunately, the machine doesn't think, however much it may appear to approach that desirable attribute. One reason is that at present the machine is brainless. But, even if it had a brain, that organ would be of no use in controlling parts completely separated. Thus far the inventor of this contrivance, Mr. John B. Flowers of Brooklyn, N. Y., has succeeded only in getting the various parts to operate, alone and by themselves—in itself no mean achievement. The machine as we have depicted it is the conception toward which he is working. It opens up a wide vista for the imagination. Think what it means for the office of the future to have an almost human machine at hand to perform the routine drudgery of typewriting and letter-writing!

Unlike most projected inventions of the kind this machine was not conceived as an idle dream. It is based upon sound technical reasoning and researches as

How the Voice Typewriter Works



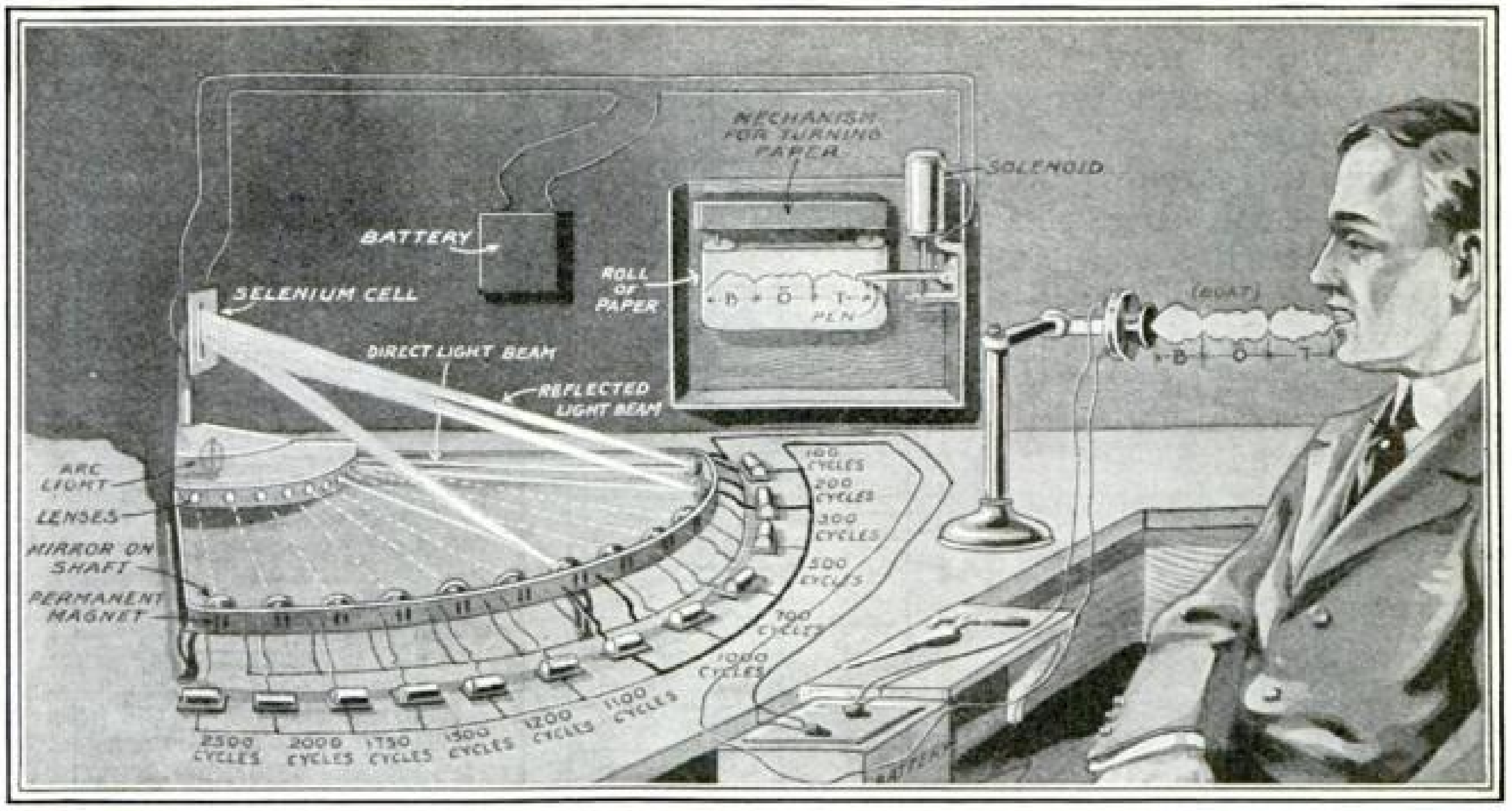


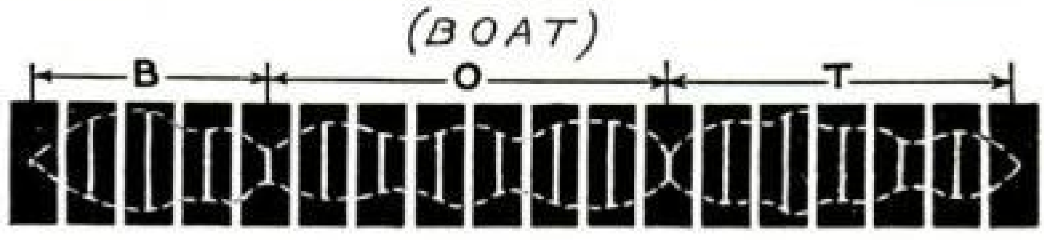
This is the machine used to evolve the natural alphabet. The man at the left is whispering into an acousticon or loud-speaking transmitter, which is attached to a heavy weight, in turn suspended by springs. The inertia of the weight and the resiliency of its spring supports, prevent exterior vibrations of any kind from jarring the extremely sensitive transmitter. Connected with its circuit is a string galvanometer. The whole arrangement is so sensitive that faint whispers readily cause the "string" to vibrate. Light from the arc light throws a shadow of this vibrating string on to the camera at right. A revolving drum carries a strip of photographic film and makes a permanent record of the vibrations. Sample records are given at left, together with an explanation below of what those particular curves signify.

These strange curves are records of the whispered and spoken vowel "U"

The strange curves shown above are records obtained from the apparatus. Upper Curve: Man's voice pronouncing the letter "U" bringing out in striking fashion the fact that any underlying curve is obscured by extra humps due to the peculiar nature of the particular speaker's voice. Middle Curve: Woman's voice pronouncing the same letter "U." Note differences from same letter pronounced by man's voice. Lowermost Curve is obtained when the letter "U" is whispered. Whispering is the most elemental way one can transmit speech, since it does not require use of the vocal cords. Contrast this curve with the two preceding. Note that instead of a series of repeating diagrams peculiar to a particular speaker's voice, a definite undulation or wave-shape now appears. In the two upper curves this underlying wave-shape was blotted out by extra curves or humps known as "higher harmonics" which arose from the use of vocal cords and were different for different men's and women's voices. This underlying wave-shape was none the less present in the two upper curves, because a sound shaped in this precise manner is necessary before the brain recognizes the letter "U" as such. Mr. Flowers' feat consists in recognizing this principle, and in demonstrating it. He whispers the whole alphabet into the transmitter of the apparatus shown above, and secures accurate photographs of the undulations, or "letter patterns" resulting. A complete set of these is shown on Page 68. Mr. Flowers found that it makes no difference who does the whispering; the same wave form for the same letter always results. Scientists recognize this as an immense step in advance, because heretofore men attempting to get at the real nature of speech have always been frustrated because the higher harmonics blurred out the true wave present. They could not deal with whispered speech because no apparatus sensitive enough to record whispered speech existed, and the curves they obtained with spoken speech varied hopelessly with each different speaker's voice.

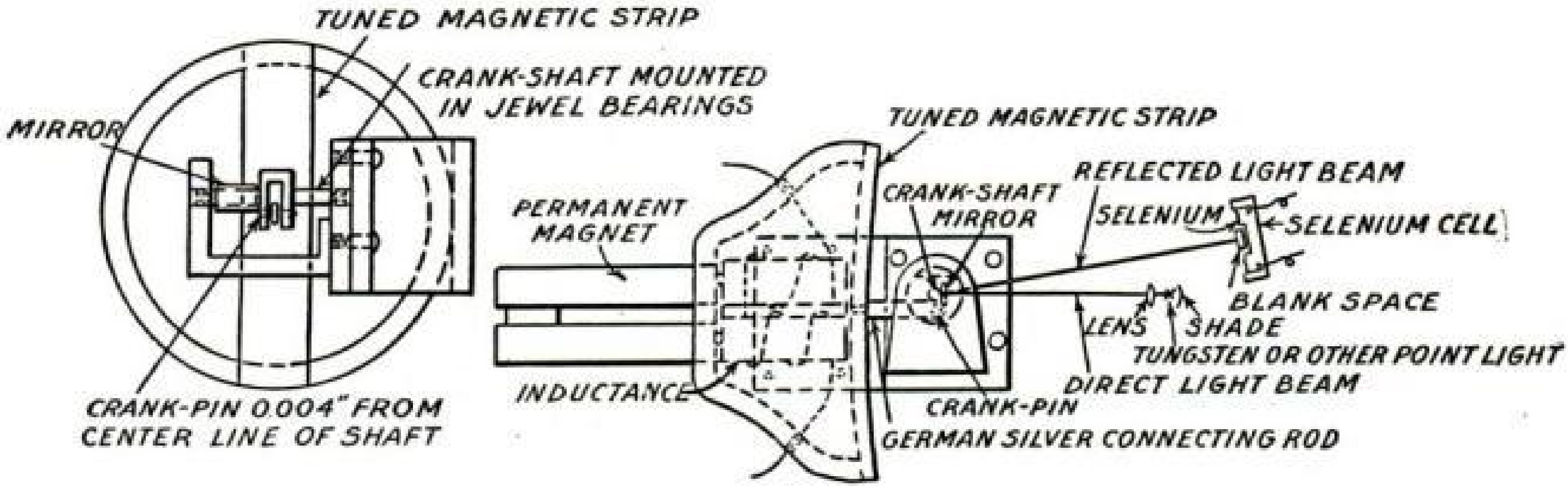
Experimenting with the Phonoscribe





This machine is sometimes referred to as a "phonoscribe." It is designed to take dictation, writing words down on paper in natural characters as fast as spoken. It is of interest here as a forerunner of the voice-operated typewriter. The man at the right is pronouncing the word "boat" as an example. The "a" in boat, being silent, produces no effect on the machine, since it must necessarily spell words phonetically, or as they sound. The "bot" sound vibrations proceed into the transmitter and affect an electric circuit in which are 12 vibrating-mirror mechanisms. Detail of these is given in the figure below. Each mechanism is tuned by the small coils back of it so that it will only respond to vibrations, or cycles, of a certain magnitude. See page 70 for further description.

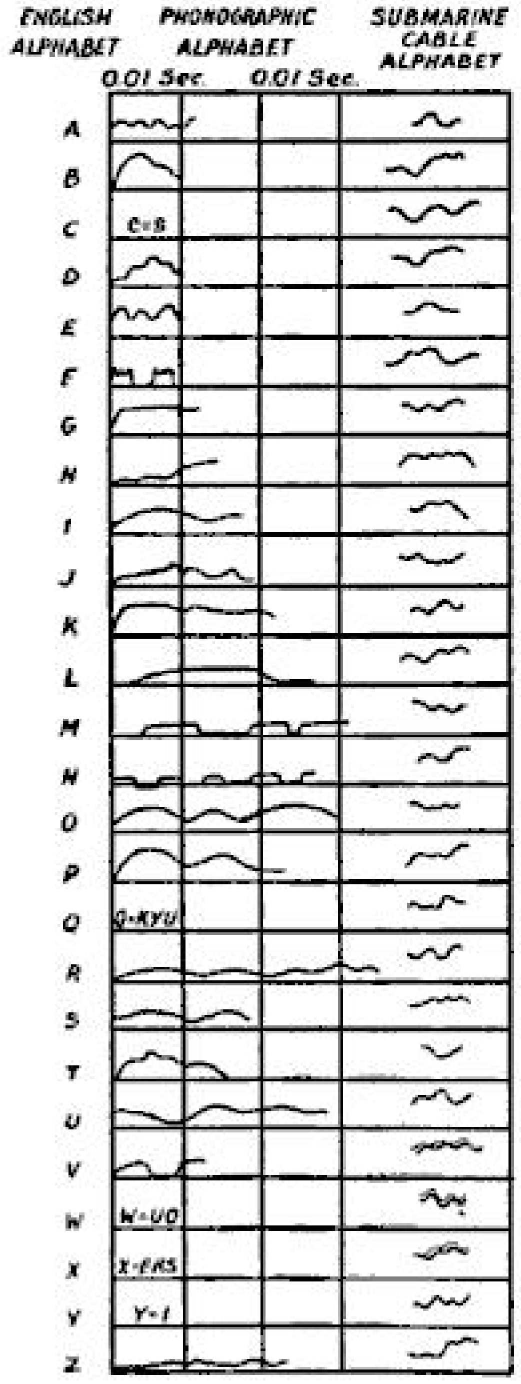
The black rectangles beneath the word "(Boat)" at right make clearer the workings of the selenium cell shown in the picture above. They may be considered a series of instantaneous views of the selenium cell while the light beams are varying in length over its surface. The white strips in the center of each view show how much the light beams happened to be vibrating at each particular instant. The white curves connecting the bottoms and tops of these strips of course have no real existence but were drawn in to show how the light-beam lengths follow the original shape of the word "boat" as sketched in, in front of the man's face. Note also how the curve traced by the solenoid and pen varied directly with the length of these light-beams, tracing the identical curve.



Detail of mirror-moving mechanism. Similar to a telephone receiver in general construction, the tuned magnetic strip taking the place of the usual diaphragm. Attached to the strip is a short lever working a tiny crank-shaft on which a little mirror is mounted. Vibrations from the strip rotate the crank slightly causing the mirror to move through a small arc and throw its beam of light up and down on a selenium cell in the manner shown in the illustration at the top of the page.

well as on experimentation, back of which were the resources of a great typewriter company.

The line of reasoning involved in designing the machine, though somewhat intricate, is exceedingly interesting. Getting any machine at all to respond to such an uncertain and variable director as the human voice, is a task beset with difficulties.



After all, what are spoken words but telegraph signals sent through the air, collected by the ear, and interpreted by your brain? Consider spoken words as sound signals and the voice-operated typewriter becomes possible

Alphabet of natural letter-patterns obtained with the apparatus shown at top of page 66. Note that the natural alphabet is not unlike that now used in submarine-cable telegraphy, though of course the two alphabets have no connection, theoretical or otherwise. The machine shown on page 67 spells out words in this natural alphabet.

This phonetic writing may some day be used in offices as a sort of short-hand system, the dictator talking into a machine similar in principle to that shown on page 67, and the stenographer afterward reading the wavy line from the roll of paper as easily as she would her own notes. The machine with its present design is entirely in laboratory form—interesting however, for the novelty of the idea on which it is based, and because it comes closest to tracing the true wave-form of speech of any machine yet devised.

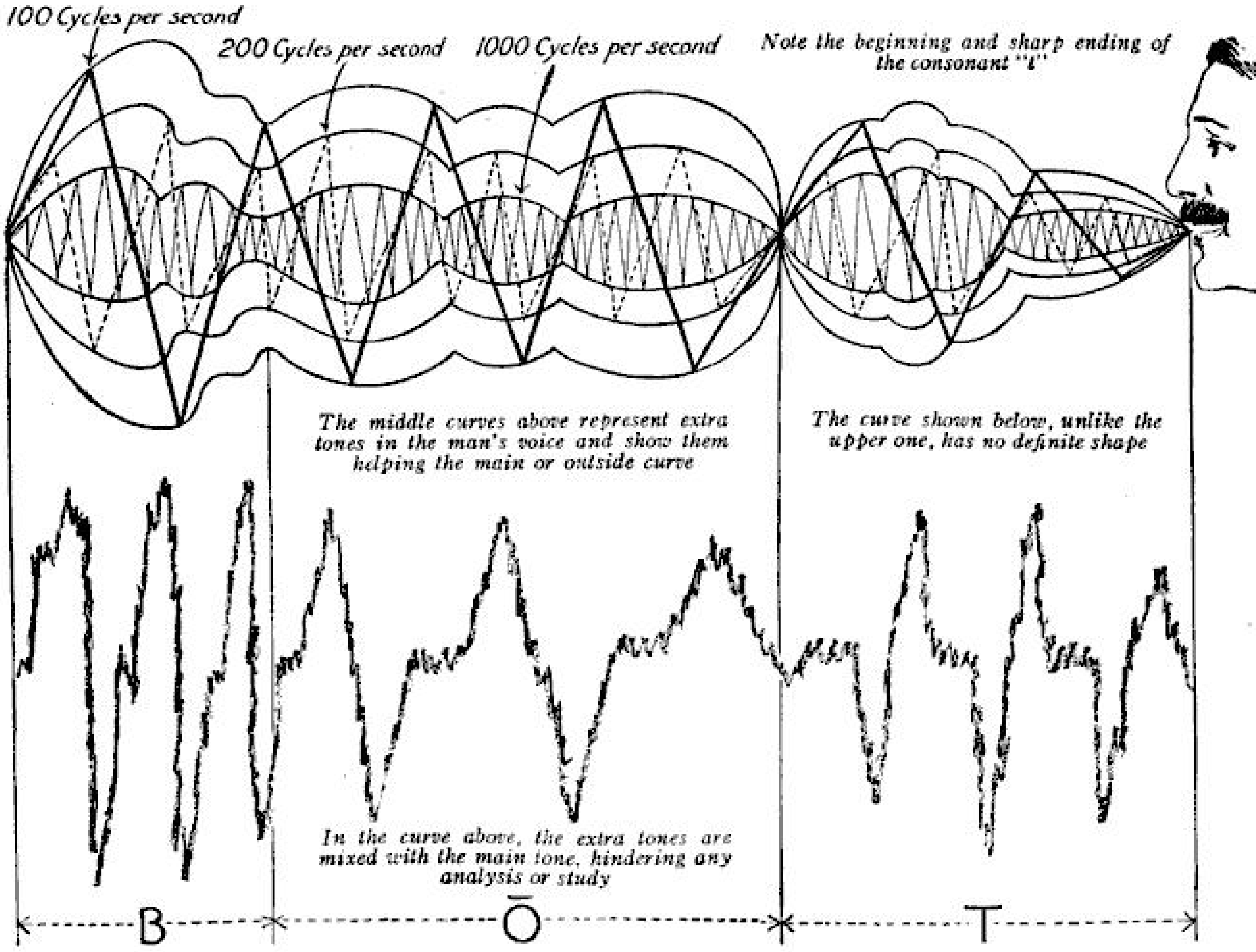
Speech Had First to Be Studied

In a recent paper which he read before the American Institute of Electrical Engineers, the inventor discussed researches lately completed into the true nature of speech, these having a great deal to do with the practical workings of the eventual machine. It was discovered that all speech can be represented by a sort of natural alphabet of sound patterns, which, no matter what the voice may be, always have the same shape. When a *man*, for instance, pronounces a given word he molds air waves in precisely the same way as does a woman. So far as sounds go, a Choctaw Indian is as well provided as a Harvard graduate; the only difference is that the sounds are grouped differently. This is a fundamental law. The mechanism of speech is the same in all of us. Heretofore physicists and workers with speech and sound have been troubled by the fact that they had nothing definite to work with. The consonant letters, when one person spoke them, would appear to have much the same wave shape as vowels enunciated by another speaker. In fact, even consonants and vowels produced by the same person sometimes seemed to have these indeterminate shapes when the scientists squinted at them through their sound-wave recording machines. Hence the task of ever getting spoken sounds analyzed and classified for study seemed hopeless. Until these letter-sounds were analyzed and classified so that somebody could reason out the real underlying law they obeyed, it was obviously impossible to go go far toward a voice-operated typewriter. One cannot simply say "Write!" to an inanimate collection of levers and expect them to respond.

Why Whispers Were Studied

The instruments which were used in determining the real nature of speech sounds are shown on Page 66. With this apparatus Mr. Flowers dealt only in whispers. Why? Because whispering is the most elemental way one can convey speech. When you whisper you make no use of the vocal cords or other complicated mouth and throat mechanisms. It may be said in passing that one of the principal reasons previous workers with speech sounds failed to get at true sound-wave shapes was that over-tones (extra tones that cause a given voice to have its peculiar and distinctive nature) caused the shape of the main tone or fundamental to be obliterated. Resonant or echoing tones arising in the

What the Word "Boat" Looks Like in Air Waves



The protuberance from the man's mouth in the upper picture is not an unnatural excresence. He is merely pronouncing the word "boat" and molding air waves in the manner shown

This shows detail of the word "boat" as pronounced by the man shown in the illustration at top of page 67. "Boat" spelled phonetically, or as it sounds, is of course "b-ō-t." Hence the curves for "b," "o," and "t," are all that need concern us here and the "a" can be left out of consideration.

These curves look complicated but are really simple and demonstrate most interesting points. In fact, they show us how we really speak, how we really mold air waves in pronouncing a given word. The upper set of curves are in the natural alphabet, as can be verified by comparing their shape with "b," "o," and "t" as given on page 68. The lower curve is the kind the old-time physics teacher would throw on a darkened screen as representing sound vibrations for such a word as "boat." It does represent such sound vibrations but they are in the crude, or unanalyzed state. The upper drawing shows the real multitude of curves whose jarring together, or "fighting," one might call it, caused the lower curve to be jagged and full of humps as it is. Mr. Flowers is the first to evolve this method of making clear the real nature of speech. Note how the machine shown on page 67 actually traces "b-o-t" on paper in natural characters, which ordinarily exist as ephemeral sound waves in front of a speaker, and which are difficult to capture and study.

mouth also aided in this. By dealing with whispers, however, the inventor at once eliminated all complications arising from the use of vocal cords and accompanying resonant vibrations. He could actually determine how it was that one's lips, teeth and tongue shaped letter-sounds and words into air waves.

As the figures on Page 66 explain, his apparatus was so sensitive that all sorts of whispered sounds could be recorded. The lower figure shows three sample records secured with the machine. Hundreds of others were obtained. It was found that each letter of the alphabet had a natural wave form of its own. This was the same no matter who the speaker was. In fact, it was found that these were the wave patterns, which, transmitted by the air, strike the ear and cause the brain to recognize a given letter as such. In other words, the letter patterns secured on photograph paper represented the actual wave shapes which everybody must use in conveying intelligence by means of

speech. It was the first time they had ever been caught and recorded. Man has been molding sound waves into speech with his mouth and lips along lines represented by these curves for thousands of years; but he didn't know he was doing it. The chart on page 68 gives a complete set of these wave patterns. Just how a man molds sound waves into patterns such as these is shown graphically on page 69, the word "boat" serving as an example. "Boat" was chosen because its various letters, as explained in the figure, make use in succession of the lips, tongue, and teeth—three of the principal agents in shaping sounds. It is, therefore, a representative example.

Splitting Up a Spoken Word for the Voice Typewriter

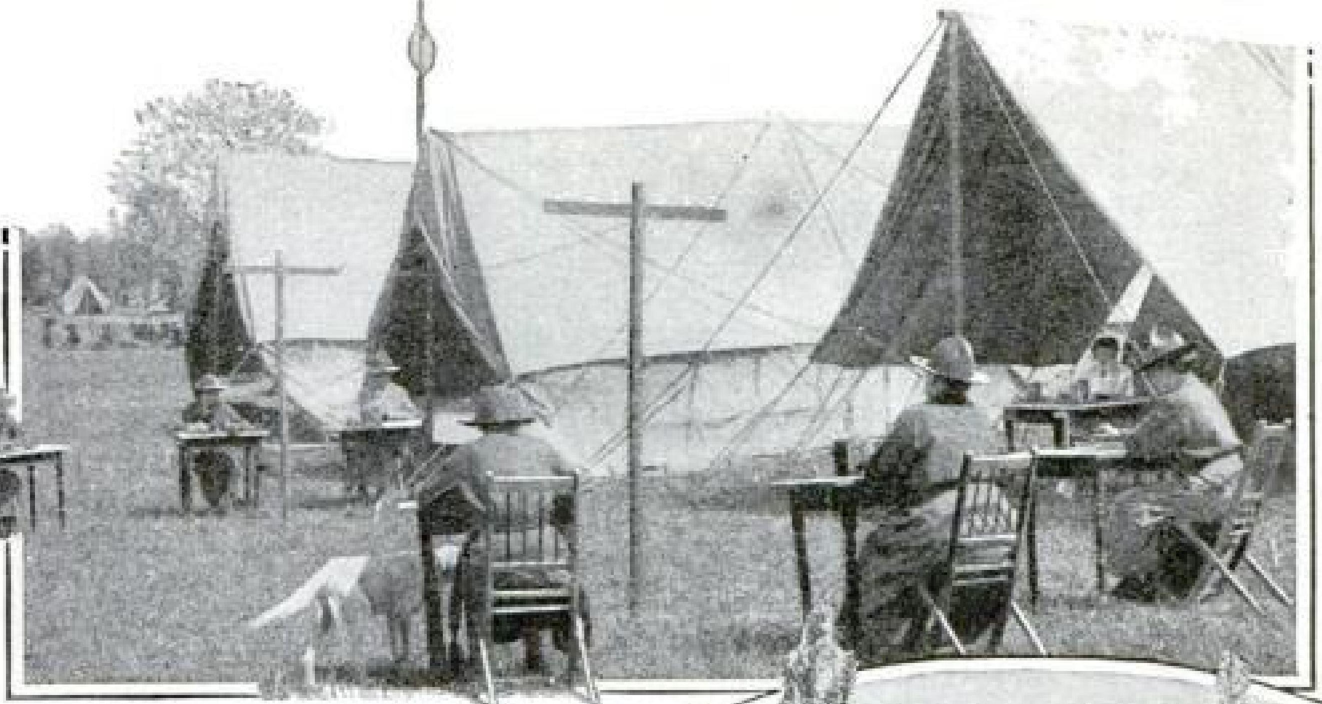
Having discovered that a set of natural letter-patterns exists, the next thing is to make use of them. Accordingly the machine shown on page 67 was designed, and has in part been made to operate. It has been named the "phonoscribe," and is intended to write down speech in natural letter-patterns automatically. As is described in the figure, it makes use of a selenium cell* and a set of special vibrating-mirror mechanisms. These latter are each arranged or "tuned," to care for vibrations only of a certain magnitude. This is necessary, for this machine is intended to deal with spoken speech instead of whispers as did the recording machine shown on page 66. Since spoken speech, as has previously been outlined, is full of troublesome extra tones which obliterate true wave forms, it becomes imperative to have such tuned mechanisms as these to strain out the main or fundamental wave from its incumbrances. As shown in the figure on page 69 the main tone has a frequency, or vibration-rate, of 100 per second. The incumbrances have rates respectively of 200 and 1,000 vibrations per second. The three mirror-mechanisms which handle these rates are shown throwing their united light-beams on to the selenium cell, enlarging and diminishing the width of this light beam in unison, and so cause the cell correspondingly to vary the electric current through the solenoid and recording apparatus shown in the center of the figure. The width of the light beams at any one instant of course depends on how much the mirrors happen to be vibrating, and this in turn is controlled by the amount of current coming from the telephone transmitter at the right. The transmitter naturally shapes this electric current to correspond with the varying sound waves reaching its diaphragm from the speaker's lips. The whole apparatus therefore works in harmony, and a string of natural characters appears on the paper, recording whatever the speaker at the right has said—in this case the word "boat."

This phonoscribe is interesting mainly as a forerunner of the actual voice-operated typewriter itself. It embodies some principles, notably that of the selenium cell and accompanying vibrating-mirror mechanisms, which will be used in the ultimate speech-recording machine itself. But in this latter case of the typewriter, a whole collection of selenium cells will be necessary—one for each key on the machine.

The selenium cells are so distributed that only one letter of the alphabet can affect them. Down inside the voice-operated part of the machine these cells will be erected to receive waves coming from the vibrating mirrors when a person speaks. The selenium cells within the machine are arranged to correspond to the characters of the natural alphabet (see chart of these, page 68). If an ordinary rotating mirror be placed in the path of the light beams coming from the vibrating mirrors, it will automatically "spread out" these beams from the straight line (such as is shown on the selenium cell of the figure on page 67) to their natural wave shape (that shown on page 68)—this on the same principle that physics teachers of old used to "spread out" sound vibrations on a screen, using a revolving mirror. The "spread-out" vibrations are intended to fall each on its own selenium cell in the base of the machine, and because of this falling on the proper selenium cell, to affect the corresponding typewriter key.

*Selenium is a metal the electrical conductivity of which varies directly with the amount of light falling on it at any given moment.

The Feminine Gender of Preparedness



At left, women seated at desks learning the routine of the field telegrapher's work. This was easy compared with retiring at nine-thirty o'clock and throwing out of camp a vender of bathtubs

Below, one of the exercises that formed a regular part of the day's work. Two weeks of this and the women soldiers were considered "fit"

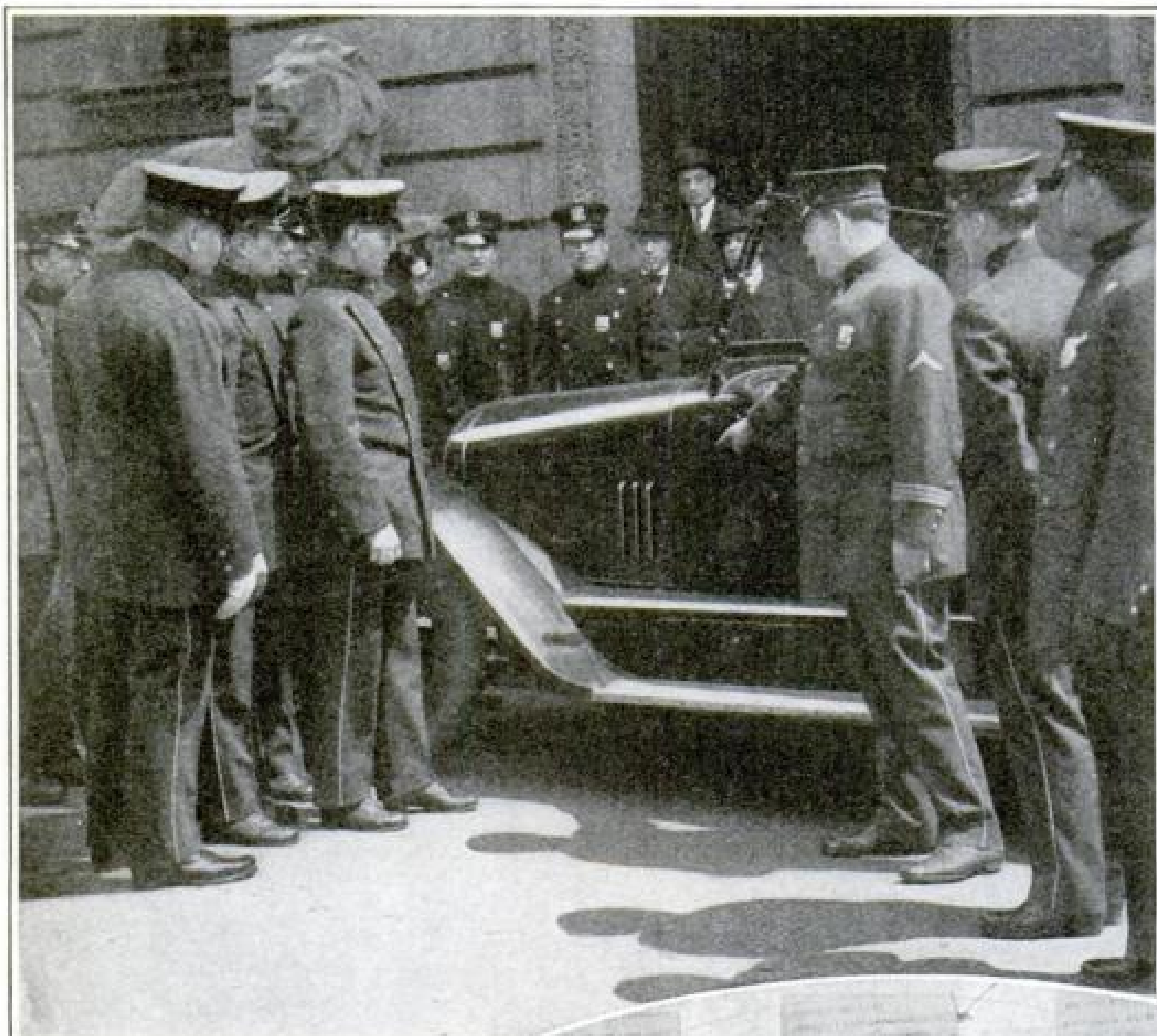
To demonstrate that getting ready for war is not a man's job alone, two hundred women from New York, New Jersey, Massachusetts and many other States have been camping since May first in quasi-military fashion at Chevy Chase, within sight of the dome of the Capitol. From reveille to taps, the latter at nine-thirty o'clock, each day is crammed full of drills, setting up exercises, lectures, classes in care of the sick and wounded and Red Cross work. The soldierettes are routed out of bed at six-thirty in the morning, after a night on a hard cot, with only fifteen minutes to reach the mess tent for a breakfast of ham and eggs, boiled potatoes and prunes. There are no maids and no morning porcelain tubs. Instead there are galvanized water buckets and agateware wash-basins. The women members of the Navy League are the sponsors of the camp and the formal name given it is the National Service School

In the hospital tent shown above, the women were taught to make bed socks, operating robes and other hospital garments

To the left, women marching in their long khaki skirts, army shirts, or rather waists, boots and broad-brimmed hats

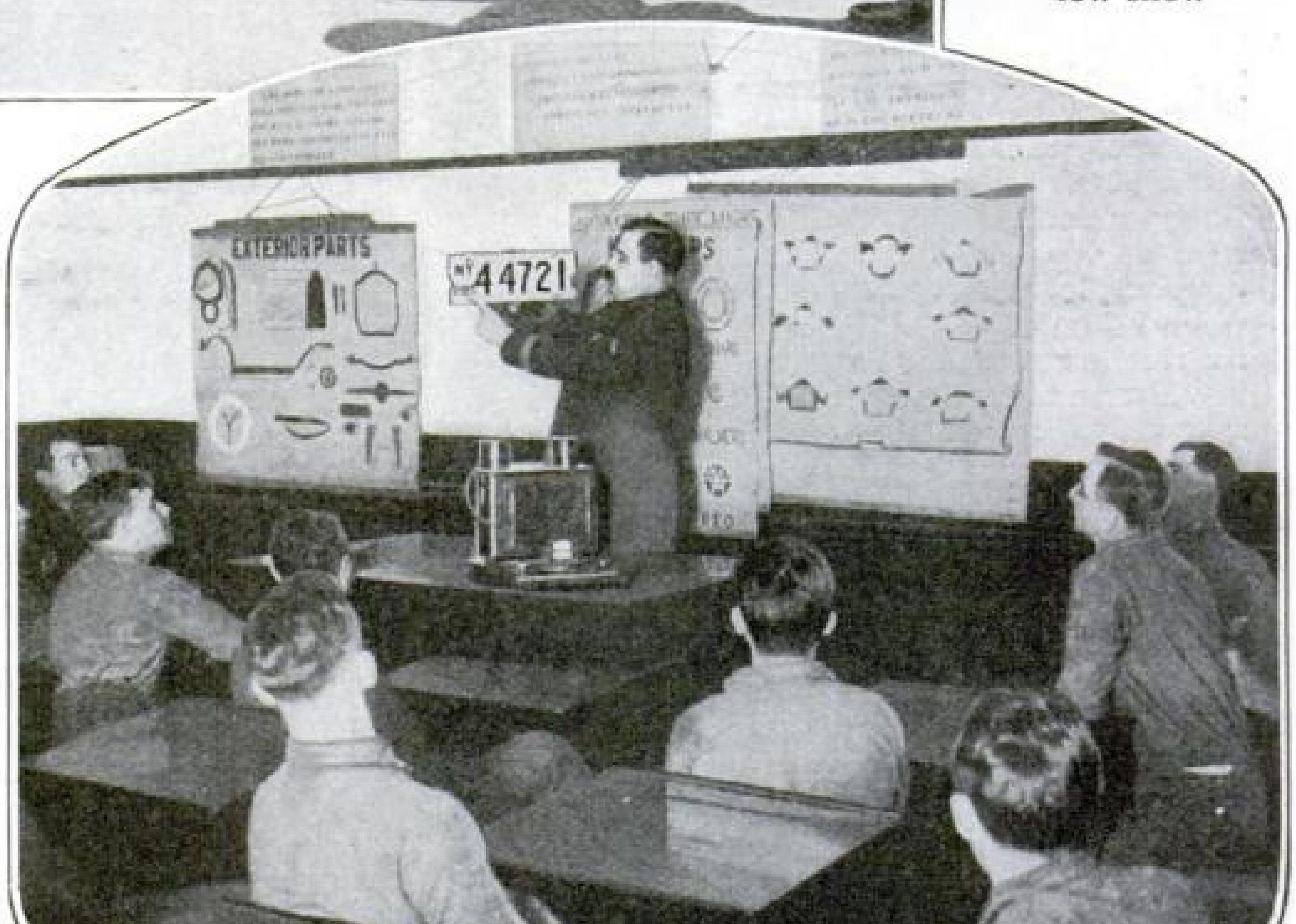
What Make of Car Is It?

By Prescott Lecky



New York's police receiving instruction in automobile identification. Fifty-four different machines are thoroughly learned so that only a glance is needed to tell the make of car

Every visible part of an automobile is considered separately. To simplify matters, the car is likened to a human being, identification being from three angles—face, profile and rear as the charts on the picture below show



HAS your car a Roman nose, or is it pug? Do its ears stand out or lop over? Its eyes—are they far apart or close together, deep-set, large, high or low?

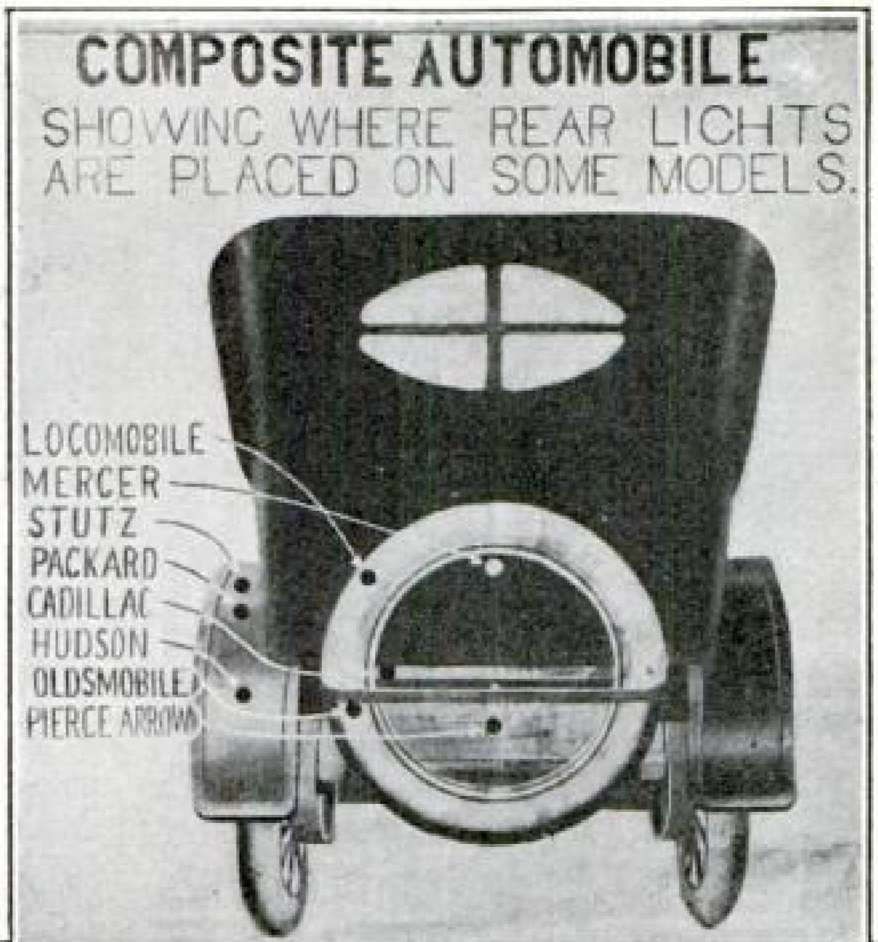
This is by no means nonsense. It is the method of automobile identification now being taught the two hundred and fifty policemen who guard the outlets of New York city, such as ferries, bridges and main roads. The characteristics of the different makes of cars have been compared and the individual features, or "factors of identification" carefully

sorted. Of two cars similar in other respects, for instance, one may have three oblique ventilators while the ventilators of the others are vertical. If no other car possessed a similar mark, it would constitute a factor. Such factors may be found on any part of the car: mudguards, headlights, radiators, hoods, gas tanks, tire carriers, springs and so on.

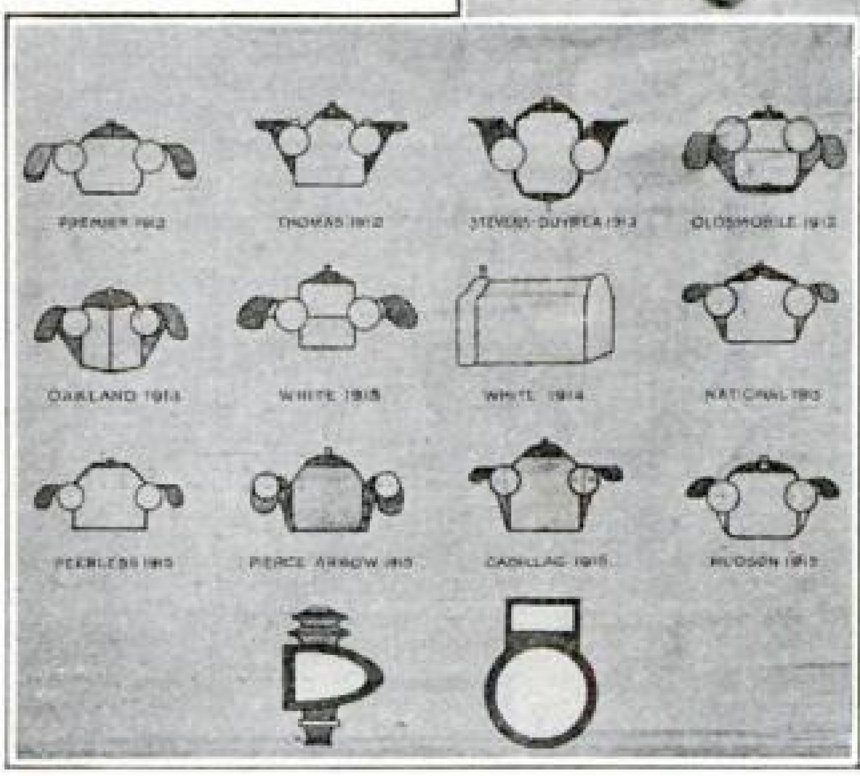
To simplify the system, the car is compared with a human being, and the patrolman is taught to identify it from three angles; face, profile and rear. Furthermore, since he recognizes each make by the factors, the trained patrolman makes a better identification for police purposes than would be possible for even the most experienced chauffeur, since he can swear to his evidence. He can cite the factors he observed as proof, whereas the chauffeur, though equally certain of his case, has nothing to support his decision as a rule except general facts. True enough in itself, nevertheless the cross-examining lawyer can make such evidence almost worthless.

In watching for a certain car in the traffic the patrolmen are taught to use the factors for rapid elimination, after Sherlock Holmes' famous precept of "observation, knowledge and deduction." If the car in question has a crown mudguard, for instance, one glimpse of a flat or oval mudguard is sufficient information. He drops the machine at once. Observing the remaining cars, or those with crown mudguards, he finds contradictory factors in all except the one he seeks.

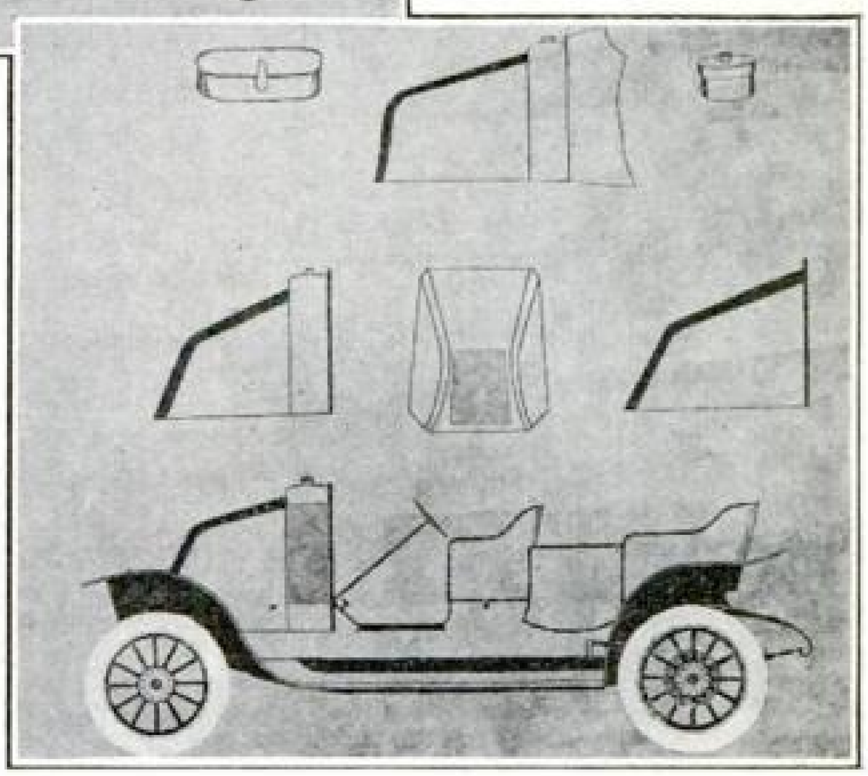
All of the outlet posts of the city are connected with a single alarm system, and the descriptions of stolen cars, cars containing escaping criminals, or those wanted for any other reason, are communicated as soon as the crime is reported. The importance of training these outlet men to know the various makes is obvious. Eventually every man on the force will receive some instruction along these lines, and a short course has already been incorporated into the schedule of training for recruits.



An escaping machine can be identified by the position of the tail-lights



Note the face, eyes and ears of these cars and how they differ from one another



The "nose" of an automobile is a good index to its lineage

Preparedness Against Bank Burglars

The military force of a peaceful Chicago bank waiting for the lone burglar to appear. These men were put through a course of target-shooting to be prepared for holdup men who had been molesting the bank and its neighborhood for many weeks

PREPAREDNESS for war was not nearly so important and timely a subject with the bankers of Chicago recently as was preparedness for gunmen. For weeks there was an epidemic of holdups in the city. In the neighborhood of one bank, the Lincoln State Bank, masked bandits swarmed at all hours of the day, victimizing no less than fifteen patrons of the bank in a single week. With the police seemingly helpless to cope with the situation, the bank took steps to protect itself and its depositors.

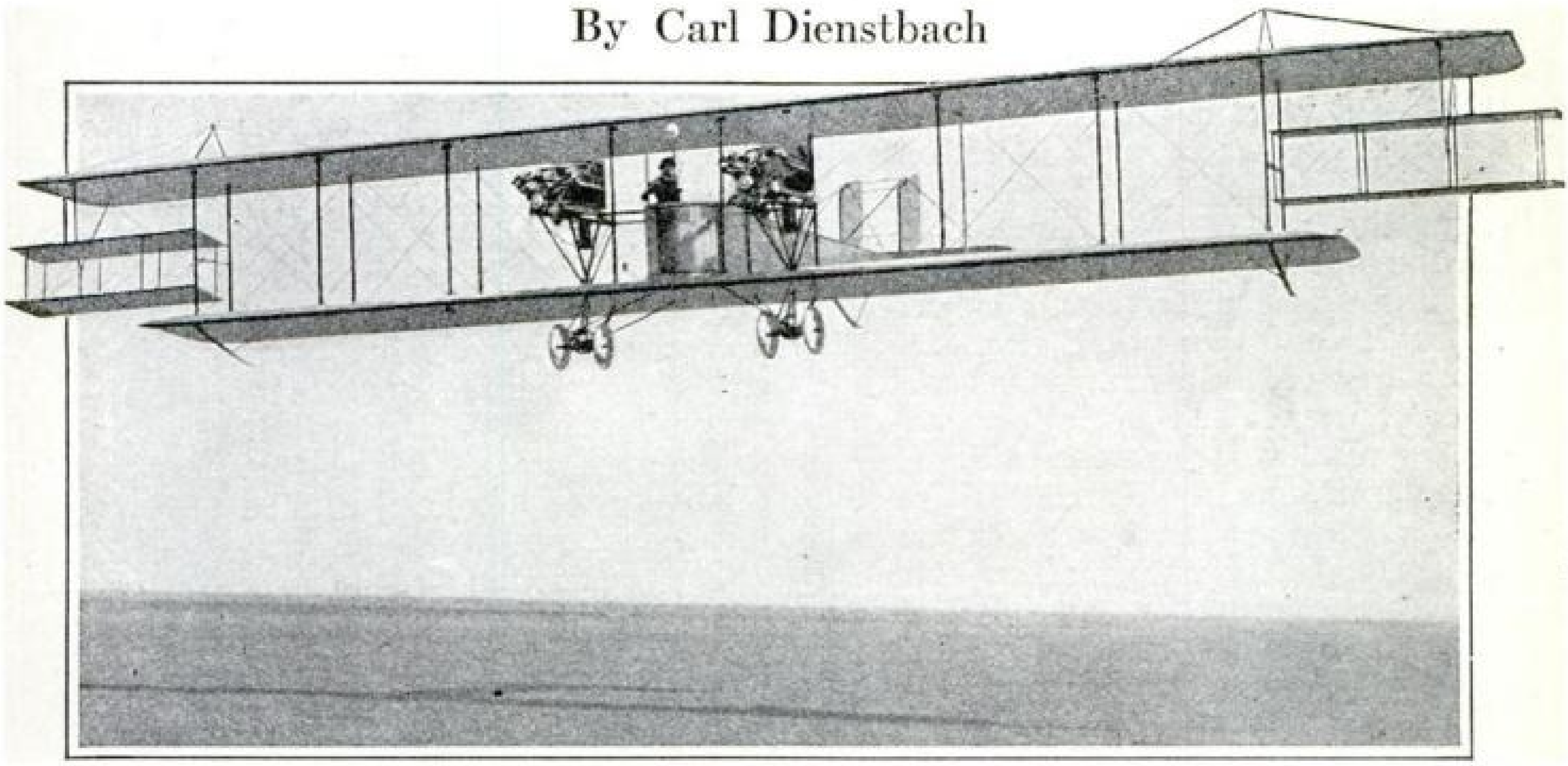
The entire clerical force was mobilized in the basement of the building one morning and the first lesson in a course on how to shoot bandits on sight was given. Each man was supplied with a revolver, a pistol range was erected, and target-practice was held. After the men were told to keep their eyes open when they shot and point the gun at the target instead of at themselves, they displayed marked proficiency with their firearms.

After a week of practice there wasn't a bandit intrepid enough in all Chicago to venture a visit to the bank. Indeed, the preparedness campaign became such a success that the holdup men forgot all about the bank and the surrounding neighborhood and migrated to other parts. In time the clerks became such crack shots and such confirmed militarists that they almost regretted the fact that they didn't have an opportunity to substitute a gunman's heart for the much maligned bull's eye.

All the specialized knowledge and information of the editorial staff of the Popular Science Monthly is at your disposal. Write to the editor if you think he can help you.

What's Wrong with Big Aeroplanes

By Carl Dienstbach



A novel feature of the first huge American land aeroplane is the use of biplanes for ailerons. This furnishes stronger control, at the expense of great head resistance

WHEN Curtiss built the "America" for an intended flight across the Atlantic, he was compelled to design a big machine. The radius of action could be extended only by providing for much fuel. Fuel became the most important freight of the bigger machine. Increase of size will not in itself materially increase the radius of action.

For the reason given, the size of the "Americas" and "Super-Americas" is not only such that the radius of action is practically extended across the Atlantic, but a somewhat greater load can be carried. The Allies' lack of fast dirigibles made them eager bidders for the "Americas." But the difficulties encountered in increasing the aeroplane's size must not be lightly dismissed. Accidents now teach their lessons quickly. The first, a very dramatic one, happened in this country when on May 11 last, a "Super-America" for passenger service between Washington and Newport News suddenly turned over into the Potomac, after performing some somersaults, wrecking itself, killing two and injuring three passengers. Similar accidents had occurred in Europe, but they were hushed up for military reasons. So rigid and strong was the large machine that axes could not break through in the effort to get at the victims below the floating wreckage. Yet, a big machine is weaker for its weight than a smaller machine. Very large sailing vessels must be square-rigged, and many small sails must be employed. Aeroplane dreadnoughts ought to be multiplanes on the same principle. This becomes imperative if the fact is considered that aeroplanes were for many years nothing better than death-traps, ready to break in midair and that it was exceedingly difficult to strengthen even the smaller types without making them too heavy. Landing on hard ground is particularly difficult. It means literally a collision with the earth. Huge flying boats are better off, their landing places are abundant and always level and wondrously soft.

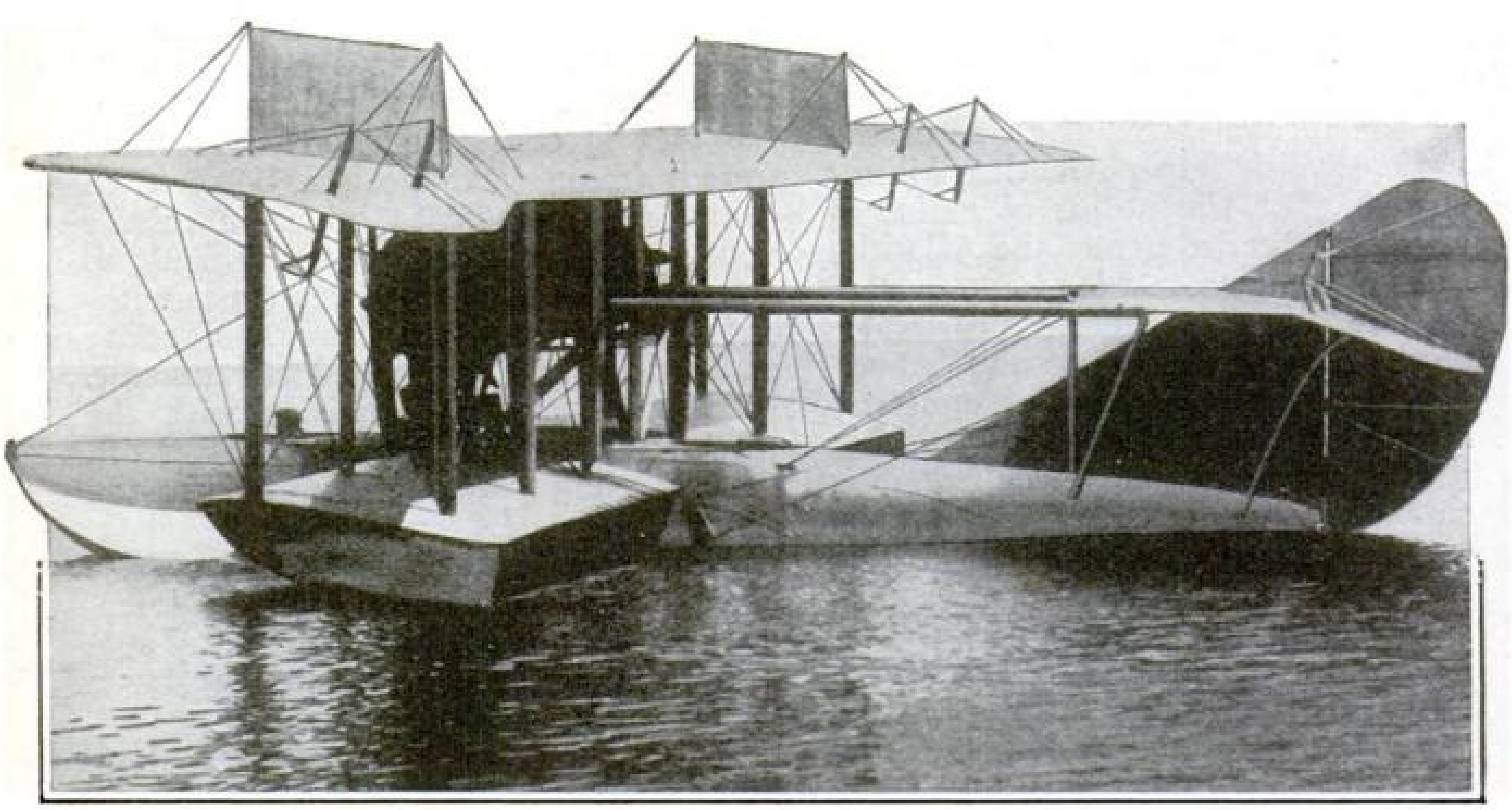
But, after the recent accident one feels like asking: Isn't the "America" a somewhat mistaken construction? May success be expected merely by enlarging a successful small model?

A mammoth steamer may get along with proportionately the same size of rudder as a smaller one because it matters little if it takes it many times longer to complete a turn. But in

balancing an aeroplane, there is no time to lose. The huge machine is treacherous because its great inertia makes it apparently stable. But once it yields a little, it tries obstinately to yield more. The necessarily wide distribution of weights around the center of gravity aggravates this inherent tendency. In the light of these considerations the idea of using biplane-ailerons on the first huge land aeroplane recently tried in this country seems interesting, a frank confession that stronger controls are needed, although an excess of head resistance at the wing tips, and objectionable leverage are the price paid for this improvement. The frame that holds the wheels has been strengthened by shortening it, which is made possible by raising the propellers and motors (to clear the ground) although the total length of framing remains the same. There is an advantage in having the lower plane thus laterally brace the length at the point it does. Otherwise the wheels themselves appear weak for a total weight of over two tons and the mass of open framework supporting the motors has undue head resistance; it has the excuse that the motors may thus be brought further ahead to increase the leverage and stabilizing effect of the tail. The weak elevator contrasts strangely with the powerful ailerons and the double vertical rudder.

To find out what really happened to the wrecked "Super-America," we must read the testimony of the tugboat captain who happened to see the accident at close range. The flyers were given no time for observations. Eye-witnesses tell of a propeller working loose and an "explosion" that scattered small fragments before the plunge came. The mere loss of a propeller and the racing of an engine should not jeopardize stability. Probably the pilot, bewildered by the injury to the power plant and handicapped by relatively weak controls, failed to counteract some air disturbance.

The machine also was only one hundred feet up, too close to the water for righting a small monoplane, let alone a dreadnought. The "somersaults" before reaching the water testify to an "America's" lack of stability resulting from lack of leverage between the stabilizing planes and the principal weights which are not concentrated enough and not large enough in proportion to the amount of momentum. All long-hulled flying-boats suffer from such a lack of leverage, with no practical solution in sight.

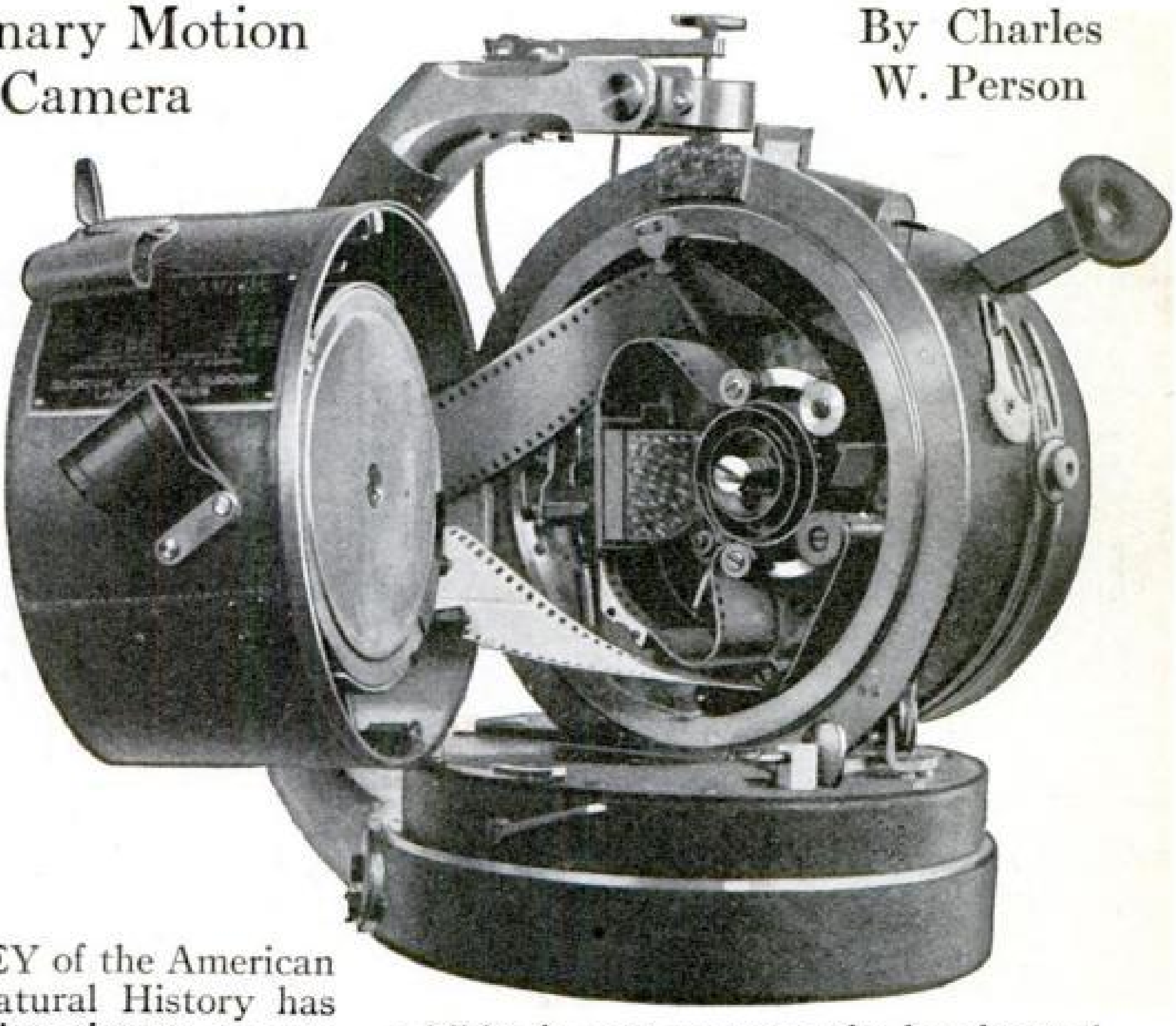


On a recent trip from Washington to Newport News this "Super-America" fell, killing two passengers and injuring three. So rigid was its structure that axes could not break through in the effort to extricate the victims

As Easily Handled as a Rifle

A Revolutionary Motion Picture Camera

By Charles W. Person



The camera opened to reveal the interior arrangement. The film box for the storage of the negative is shown at the left and the film leads from it to the exposing or camera mechanism opposite. To operate the camera the two parts are locked together to form a compact unit

CARL E. AKELEY of the American Museum of Natural History has evolved a motion-picture camera so novel in its constructional and operating features that it gives promise of revolutionizing at least one of the diversified fields of motion-picture photography—that of the naturalist and big game hunter. It is the first motion-picture camera equipped with the necessary mechanism to enable it to enter the hitherto unexplored realm of the hand or still camera and thus place within the scope of the operator all the vast possibilities of quick action and instantaneous photography.

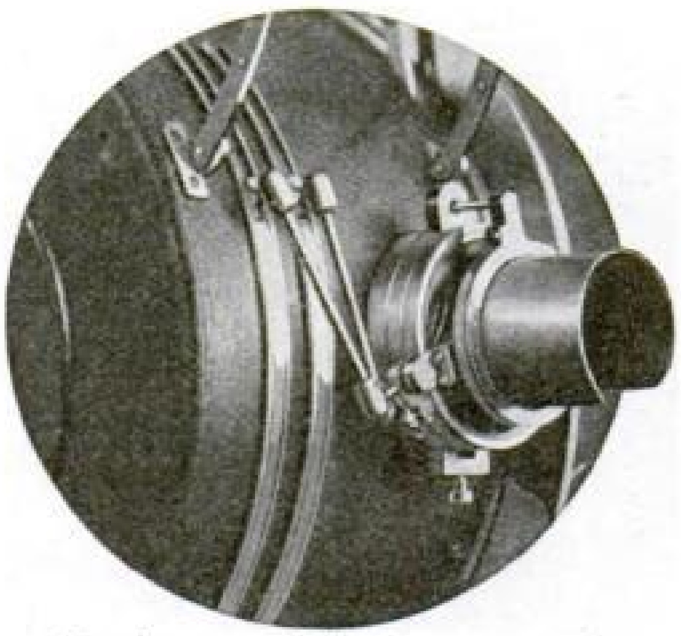
It is only natural that Mr. Akeley should accomplish something permanently valuable in motion-picture photography, since his wide experience as explorer and inventor has enabled him to discover at first hand the many limits and inherent deficiencies of the modern apparatus. As an inventor he is identified with the cement-gun and with many accessories to the hunter's craft, but he is perhaps best known as the man who has elevated taxidermy from the upholstery trade into an art. Many animals which form the most valuable exhibits in our museums he has hunted and killed in their native haunts, sculpturing their bodies in clay before he covers them with their own skins.

As a hunter of big game in the wilds of Africa he has used the ordinary motion-picture camera, to find it deficient and even useless. He has attempted time and time again, and at risk of great personal danger, to photograph a herd of charging elephants, or an alligator stealing on its prey, or a trapped lion in its death throes, only to be disappointed in the finished film. He once had the rare opportunity to photograph a real battle between giant ants of the tropics, but before he could adjust the intricate mechanism of the camera and set it up it was too late. It was disappointments like these that stimulated him to concentrate his technical knowledge on plans for a new camera.

There are parts of the Akeley camera which have yet to be named—they are so new. Indeed, the instrument is such a radical departure from the newest of the old-style machines, that it has few features in common with them. Primar-

ily it was constructed to enable the operator, under all conditions, to take a picture in a minimum of time. To be exact, it can be mounted and trained on an object in thirty seconds, which is a feat impossible with the old-style apparatus. Furthermore, it can be rotated either in a horizontal or a vertical position, and it can take panoramic pictures at any rate of speed desired. These are only two of many important features which show the versatility of the machine.

The ordinary motion-picture camera is limited in operation to an angle of forty-five degrees above or below the horizontal. It must be used on a tripod, carefully leveled. In taking panoramic pictures, two cranks, one for the horizontal movement, and the other for the perpendicular movement, must be turned simultaneously, either forward or backward, according to the direction of the swing required. Moreover, the panoramic action is confined to rectangular movements.

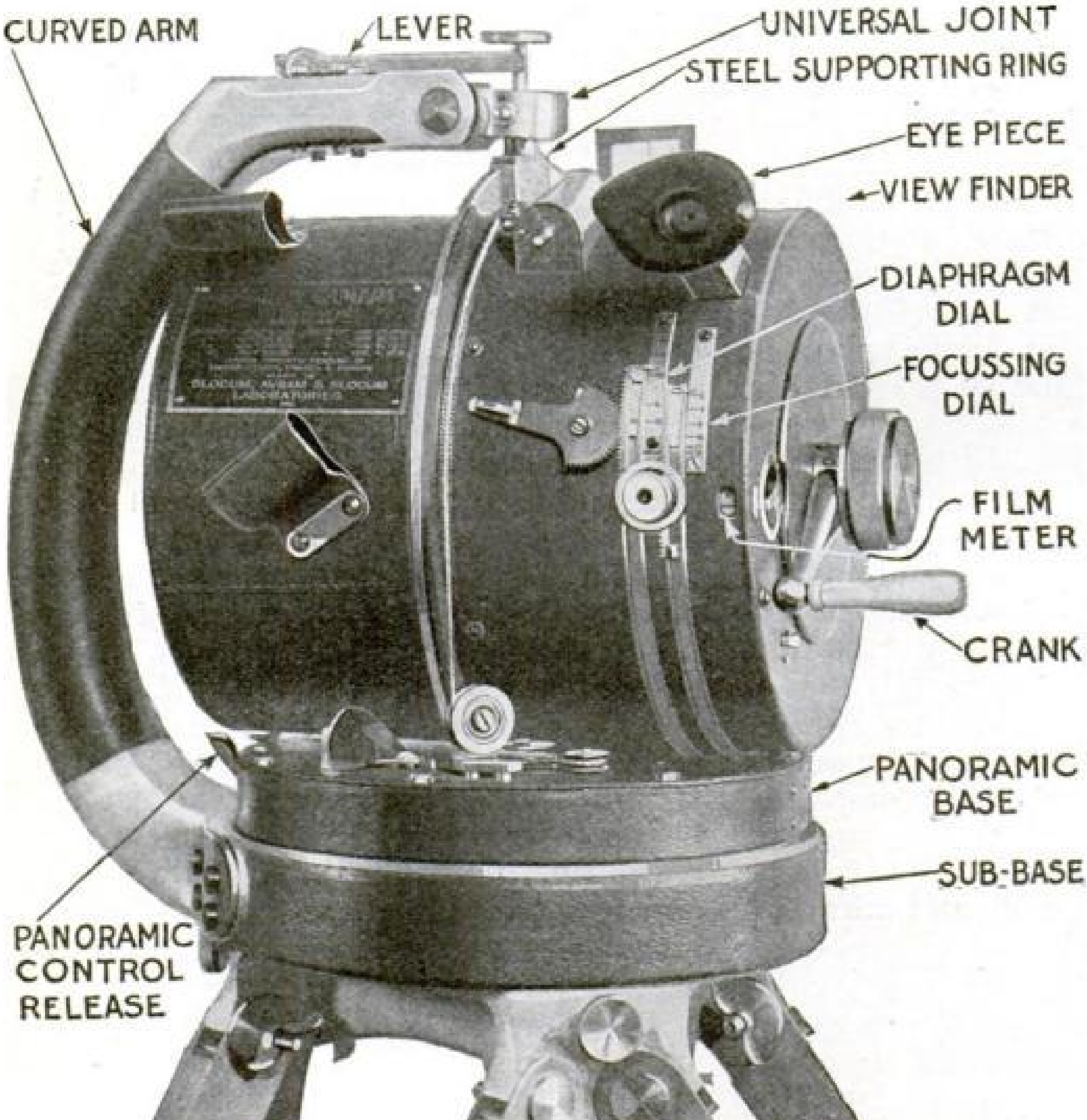


The lens and diaphragm mechanism which is automatically operated from the rear

Other restrictions are the awkward lens adjustments; the friction of the film, which causes static electricity; excessive noise, making the machine impracticable for nature and wild animal photography; its bulkiness and weight; the long time required to assemble it and prepare it for operation; the lack of climate-resisting qualities; the numerous loose parts and accessories, and other handicaps too numerous to mention here.

The camera invented by Mr. Akeley overcomes these imperfections with a mechanism entirely new. In form his camera is cylindrical. It rotates in a steel ring on ball-bearings and is supported by a curved arm, which rises from a sub-base on which the panoramic-base rests when in operation. The complete apparatus, camera and panoramic devices, form a single compact unit to be used with or without a tripod.

By merely pressing the lever at the top of the



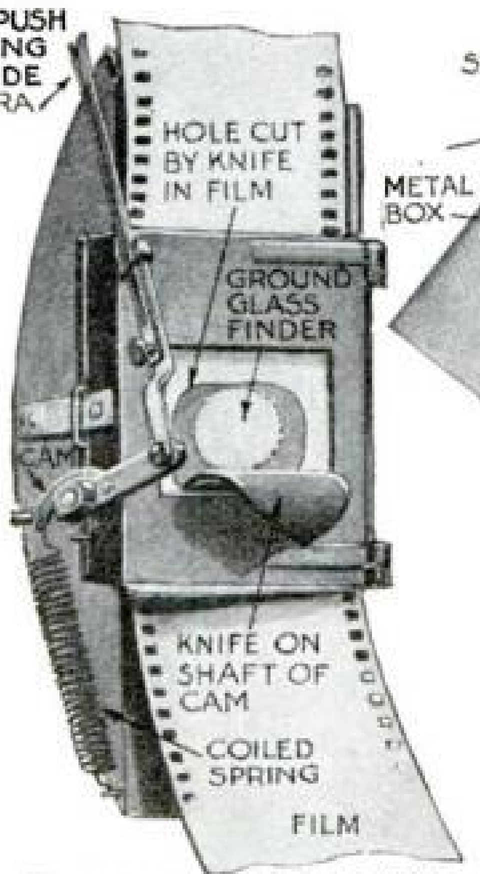
By guiding pressure of the left hand the instrument moves on its sub-base and is trained in any direction at the will of the operator

Details of a Remarkable Motion-Picture Camera

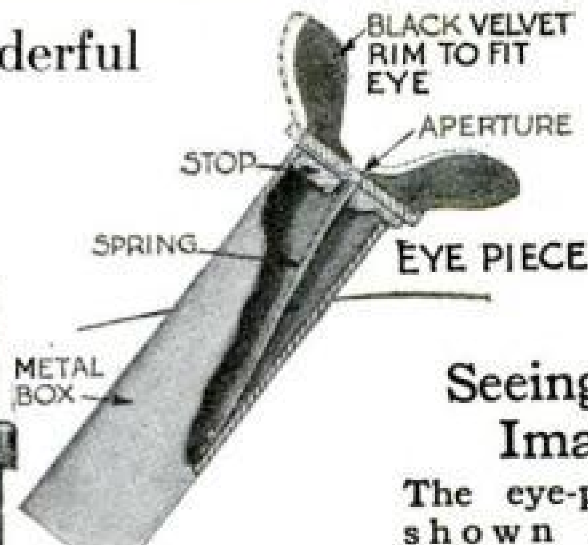
Carl Akeley's Wonderful Invention

The Film Cutter

Five features distinguish Carl Akeley's camera from all existing apparatus. The film cutter shown at the right is used to cut a hole in the film to indicate to the developer when a given series has come to an end. The hole is also used as an aperture through which the operator can stop the machine, puncture the film, and then focus to a dead accuracy on a ground glass. Consequently, when the film is developed the perforation notifies the operator exactly where the stop was made. The cutter is actuated by a pull and push rod leading to the outside of the camera. One push of the rod cuts a hole in the film and brings the ground glass into position. An eye-piece attached to the film cutter enables the operator to locate the image on the ground glass and regulate the focussing and diaphragm dials



THE FILM CUTTER AND GROUND GLASS PLATE



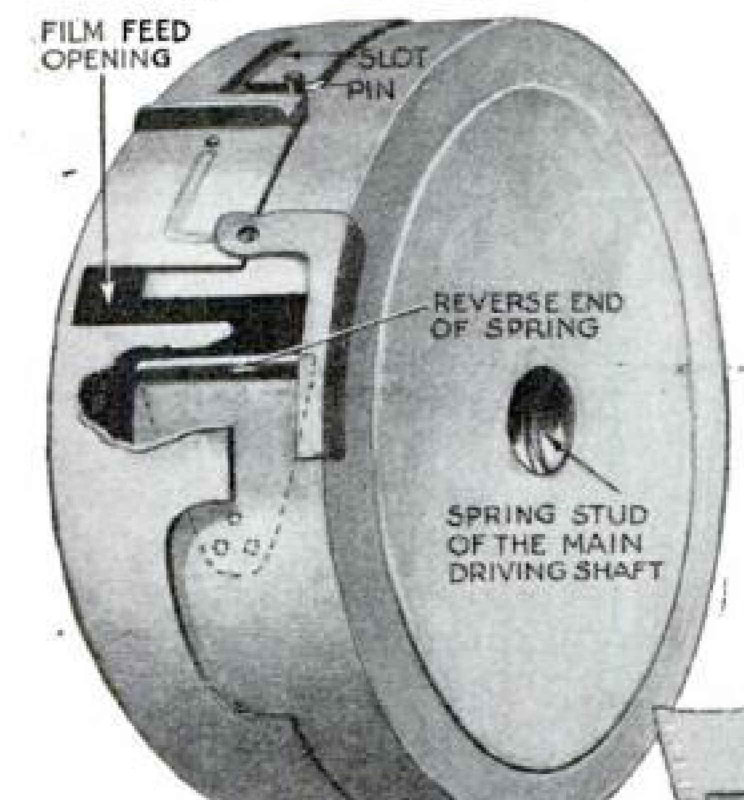
EYE PIECE

Seeing the Image

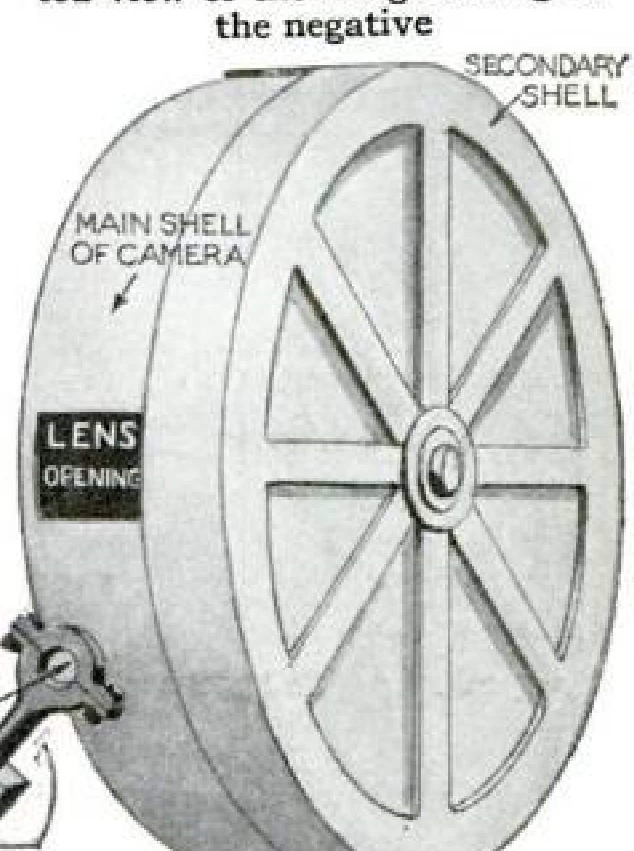
The eye-piece, as shown above, enables the photographer to see the actual image being recorded on the negative—something hitherto unheard of. It consists of a square metal box with a sliding end fitted with a light-proof, black velvet rim for the eye. A spring which serves to lift the eye-piece up and which closes the finding aperture by a metal stop at the same time, is pressed down when the eye rests against the rim. This gives the photographer an unobstructed view of the image falling on the negative

Getting Rid of the Flicker

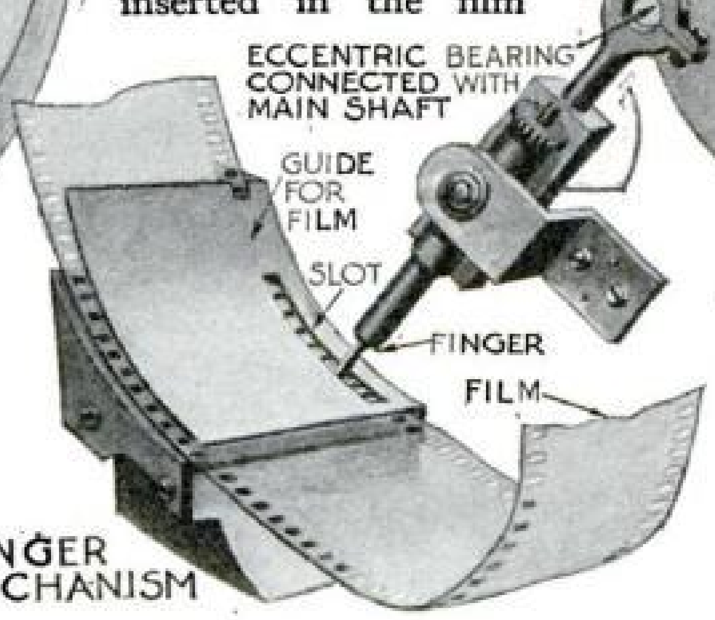
The finger mechanism illustrated below controls the speed and feed of the film. As the main shaft revolves the eccentric bearing operates the finger, which passes through a slot in the film guide and engages the perforations of the film. As the main shaft turns, the finger is inserted in the film perforations and withdrawn from them one by one so that the film is literally picked along. This gives a uniform movement and entirely eliminates all "jerkiness"



FILM BOX



SHUTTER
½ CIRCUMFERENCE OF CAMERA



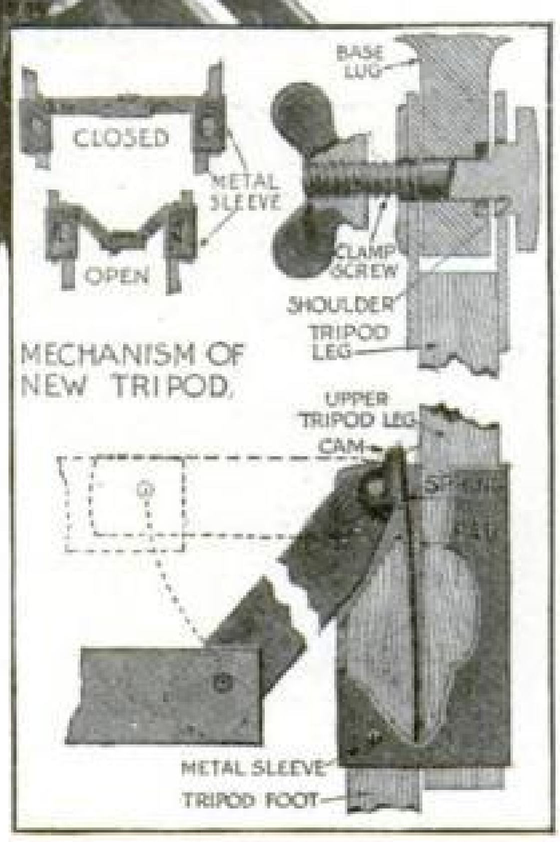
FINGER MECHANISM

Eliminating Friction of the Film

The film box, as shown above, consists of two telescoping shells which are locked together by a pin and slot device. The inner shell has a spring with a roller end over which the film feeds out. This roller end serves to eliminate friction and also prevents scratching while taking pictures. The spring stud of the main driving shaft locks the film box with the driving gears, which in turn rotate the film at the speed set by the operator

How the Shutter Works

The shutter, illustrated above, consists of the main or outer shell of the camera containing the lens opening and a secondary shell half cut away, this latter being the shutter proper. As the secondary shell revolves over the main shell the lens opening is alternately closed and shut by that portion of the secondary shutter which has not been cut away. The exposure efficiency is increased to eighty-five per cent



Above, focussing straight down. As shown at the right, each foot-member of the tripod is attached to a sleeve, the inner end of which is a swinging cam bearing upon a spring attached to the tripod leg. The spring has a felt pad which locks the tripod members together by friction, the lever system (shown closed and open) being used

supporting arm the camera automatically levels itself and upon releasing the lever remains rigidly in that position. Without requiring any previous adjustment or setting, as is the case with the cameras generally used, it can be quickly adapted to any kind of panoramic view to be taken. A horizontal panoramic adjustment may be readily changed to a vertical adjustment and vice versa, while by manipulating the finger-piece the direction of rotation and the speed at which such rotation takes place may be adapted to prevailing conditions in a quick and reliable manner.

The camera can be mounted in the twinkling of an eye for rapid picture-taking. It can be trained in any direction as accurately and as quickly as a cowboy can draw a gun. If a tripod is not at hand a window-sill, a rock, a saddle-horn, a tree-branch, a knee—in fact, anything stationary may serve as a base for operations.

Where quick action is absolutely imperative, the newspaper photographer can film every stage of an exciting fire rescue, or a riot, or a sinking ship, or an explosion, or a shooting, or, indeed, anything heretofore solely within the compass of the hand or still camera.

The lens adjustments, instead of being in front, are in the rear, so that focussing through a diaphragm according to light conditions may be carried on while the picture is being taken. By means of an ingenious eye-piece the actual image on the film may be observed during the process of exposure. To appreciate the importance of this, it may be said that it never has been accomplished before in either still or motion cameras. The eye-piece remains closed until the eye is pressed against a light-proof, black velvet rim; the actual image being recorded on the negative is seen.

It is impossible to turn the camera so rapidly in any direction that a blur is produced. The range of tilting and "panoraming" permits the operator to turn his lens straight up or straight down beneath the camera itself. This enables the operator to photograph an ant hill or nest one moment and a Zeppelin the next. All friction danger is eliminated so that the film can not be scratched while taking pictures. The camera complete weighs thirty pounds; the old-style apparatus weighs from fifty to seventy-five pounds.

The film-containing box has very little in common with the boxes now used. The camera may be run at the standard speed of sixteen pictures a second, or the speed may be doubled or trebled, as desired.

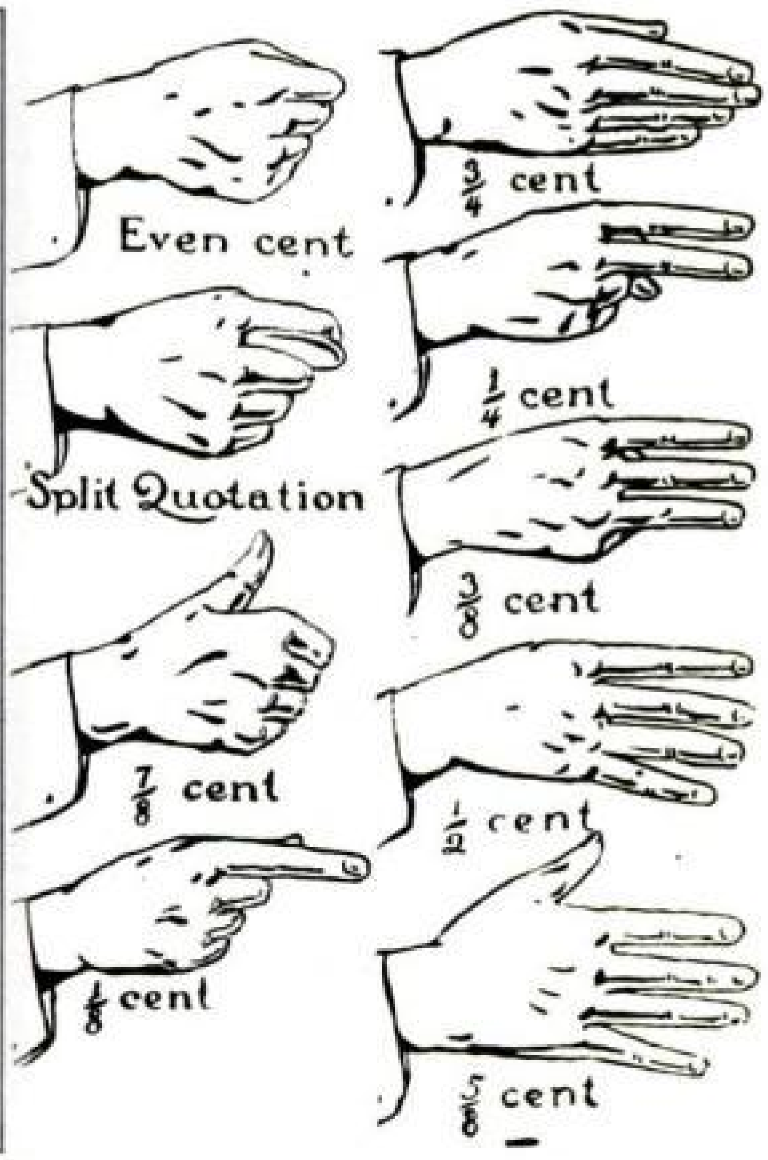
The Finger Talk of Chicago's Wheat-Pit

THE Chicago Board of Trade is by far the most important grain exchange, not only of this country, but of the world, and few people are familiar with its method of operation.

People who visit the Board of Trade are perhaps most impressed by the sign language used in buying and selling grain for future delivery. Unlike anything else seen in any other line of business this wonderful system, while simple in its execution, nevertheless puzzles the uninitiated. It is a system that has grown up with the Board, and traders would be helpless without it. In that awful din where hundreds of men and boys are rushing about and shouting and countless telegraph instruments are clicking, individual voices are smothered and the trader must talk with his hands.

He has no time to waste—a lost second may mean hundreds of dollars to him. By a simple movement of his fingers the trader makes it known whether he would buy or sell, what price he is willing to pay or take and what quantity he wishes to trade in. All the information necessary to consummate a deal, involving perhaps thousands of dollars, is conveyed by a few motions of the hand.

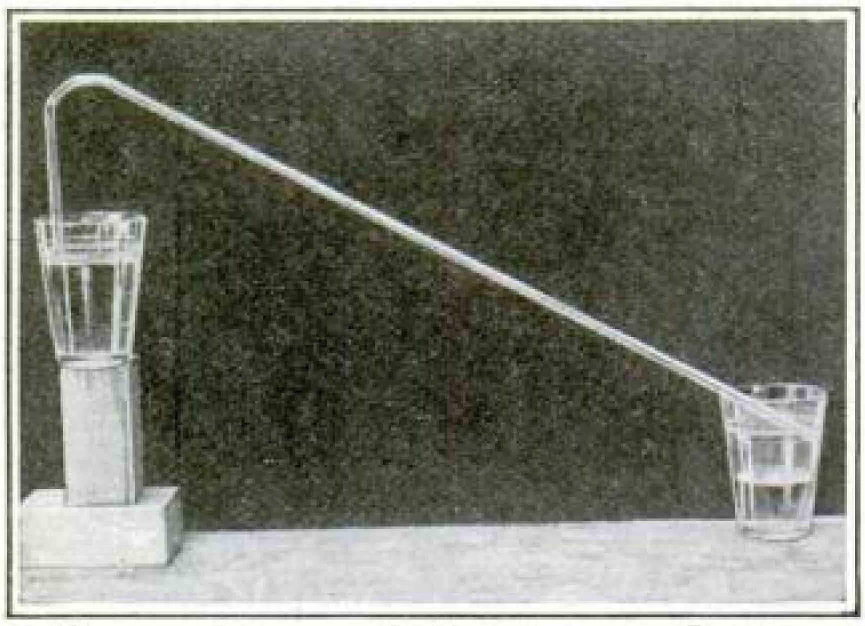
Each finger extended represents one-eighth of a cent. Thus when all four fingers and the thumb are extended, all being spread out from one another, it means five-eighths. When the four fingers and thumb are extended, but are pressed close together, it represents three-quarters. The clenched hand with the thumb alone extended is seven-eighths, while for an even cent the closed fist is used. The thumb protruding between the index and big finger is the signal for a split quotation. Nothing less than 10,000 bushels can be traded in on a split quotation, which if 90⅝—¾, means that half is taken at 90⅝ cents and half at 90¾ cents. These characters refer to the price, and the hands and fingers are held in a horizontal position. When displayed vertically the quantity is indicated, each extended finger representing 5,000 bushels. When the desire is to sell, the palm of the hand is held outward, and when the trader wishes to buy he signals with the palm facing him.



Where voices are smothered in the din, and where seconds may mean fortunes made or lost, traders resort to an effective sign language to buy and sell grain

Experimenting with the Siphon

A SIMPLY-constructed siphon offers a most fertile field for amateur experimentation. In some cases water can be made to flow straight up twenty feet into the air until it passes the curve in the siphon and flows down again.



Two tumblers, one higher than the other, joined by glass tubing, can be used to demonstrate the siphon principle

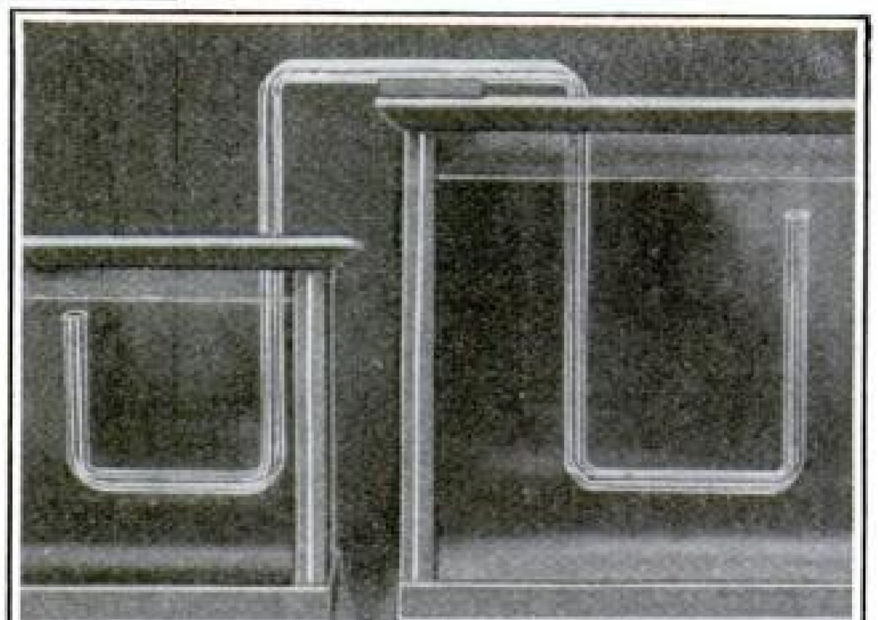
The water will easily flow to a height of six feet with the apparatus shown at the right

To carry on a series of experiments all the apparatus needed is a piece of glass-tubing and a connected piece of rubber-tubing. The glass tube may be bent in an alcohol flame, and a siphon so constructed that it will take water upward for six feet or more, and then downward in the other arm. If the joints are made tight the water will flow even higher. When the water has passed from one vessel into the other, the lower vessel may be raised, and back the water will flow, thus running uphill and downhill. The only difficulty in this experiment, aside from making the joints tight, is to fill the pipe at the start. This may be done by filling the entire pipe when the parts are all on the same level. The ends may then be stopped and the one end raised into a perpendicular position.

But with all siphons of this kind the trouble is to establish a permanent conduit between the two receptacles, since the siphon will exhaust itself unless the higher vessel is always kept filled. A siphon will not wait for a fresh supply of water, but will empty itself and cease to act.

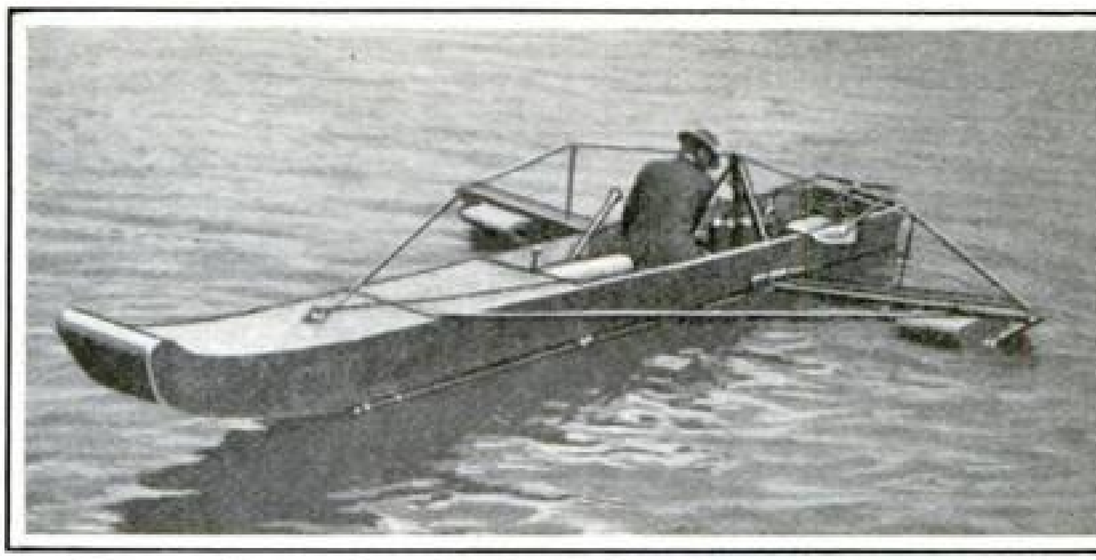
Recently one experimenter was obliged to devise a means whereby the siphon would hold its contents and wait for a fresh supply. This was accomplished by turning up one or both ends of the siphon. By this method a series of aquaria was connected so that water would run through the tubing and wait for a supply; that is, a tiny stream would keep the supply to the siphon running continuously, and the siphon would hold the water running at a permanent height.

Theoretically it is the push and not the pull that causes the water to run. The pressure of the air on the surface of the water in the upper vessel pushes the water up to take the place of what would be a vacuum. The action is similar to the pull on the part of two pulleys, in which one is heavier than the other. It is evident that the heavier weight pulls up the lighter. So it is with the siphon. The curved angle of the siphon takes the place of the pulley, and the long arm full of water takes the place of the heavier weight. Once the long arm full of water starts it "pulls" the contents of the shorter arm.



How the glass tubing is arranged when two large jars of water are to be siphoned. The test may be carried on indefinitely by reversing the position of the tubes

Forty Miles an Hour on the Water



Forty miles an hour is the claim of the inventor of this craft, which partially rises out of the water when it is under full speed

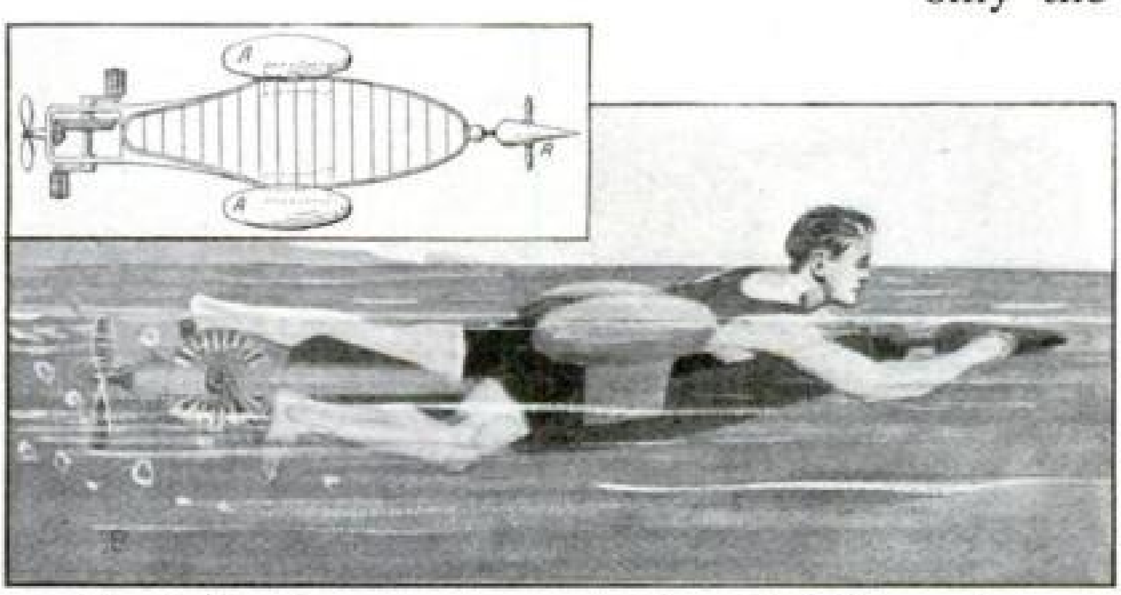
A BOAT has been designed by D. N. Brown, of Grand Haven, Mich., which, on test runs, has attained a speed of forty miles an hour. The body of the craft is made of thin galvanized iron over a basswood framework two feet wide and twenty feet long. Two galvanized iron air-tanks are attached to an outrigger five feet from the rear end on both sides. When the four-cylinder motor, set in the rear, whirls a six-inch propeller, the prow rises out of the water and the craft skims along like a huge bird over the surface, the entire weight resting on about three feet of the stern. The two tanks maintain the equilibrium.

The boat has proved a success in all ways and the inventor believes, with an improved design, that he will have a craft capable of making sixty miles an hour without being crowded.

It is evident that the inventor reduces skin friction as much as he can, for which reason he is able to travel at high speed in his boat.

What Ho! The Jitney Yacht

THAT every man who runs may cruise the seven seas, a jitney yacht has been evolved. It is indeed a peace ship—a one-piece—one man, semi-submersible. A glance at the anatomical chart appended, will explain the action of this rakish craft. Lie down comfortably upon the keel of the ship (which should be so laid as not to interfere unduly with any of your spinal peculiarities), grasp the conical rudder-control with both hands, set your gaze intently upon your goal and pedal for dear life.



The timid swimmer can now go through all the motions of swimming while being supported by a concealed water-bicycle

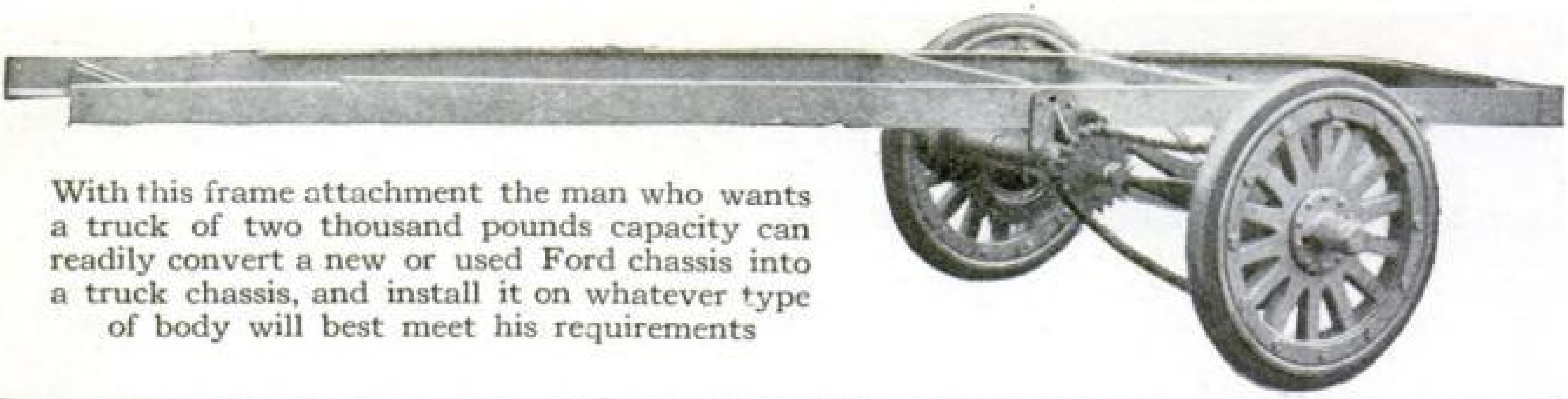
The rudder is a ball and socket affair that will steer the ship in any direction in the water. The pedal-propeller-gearing is at a two to one ratio to insure speed, and the pontoons *A A*, are inflated to the required buoyancy; *i. e.*, to float about one-third out of the water.

With a score of these one-man scouts darting across the water a battleship's squadron might anchor in perfect security and laugh at the deadly submarine. Or they might be hitched tandem, so that you may invite your fair lady to take the air on the ocean and save not only the carfare to the nearest beach, but bath-house hire as well.

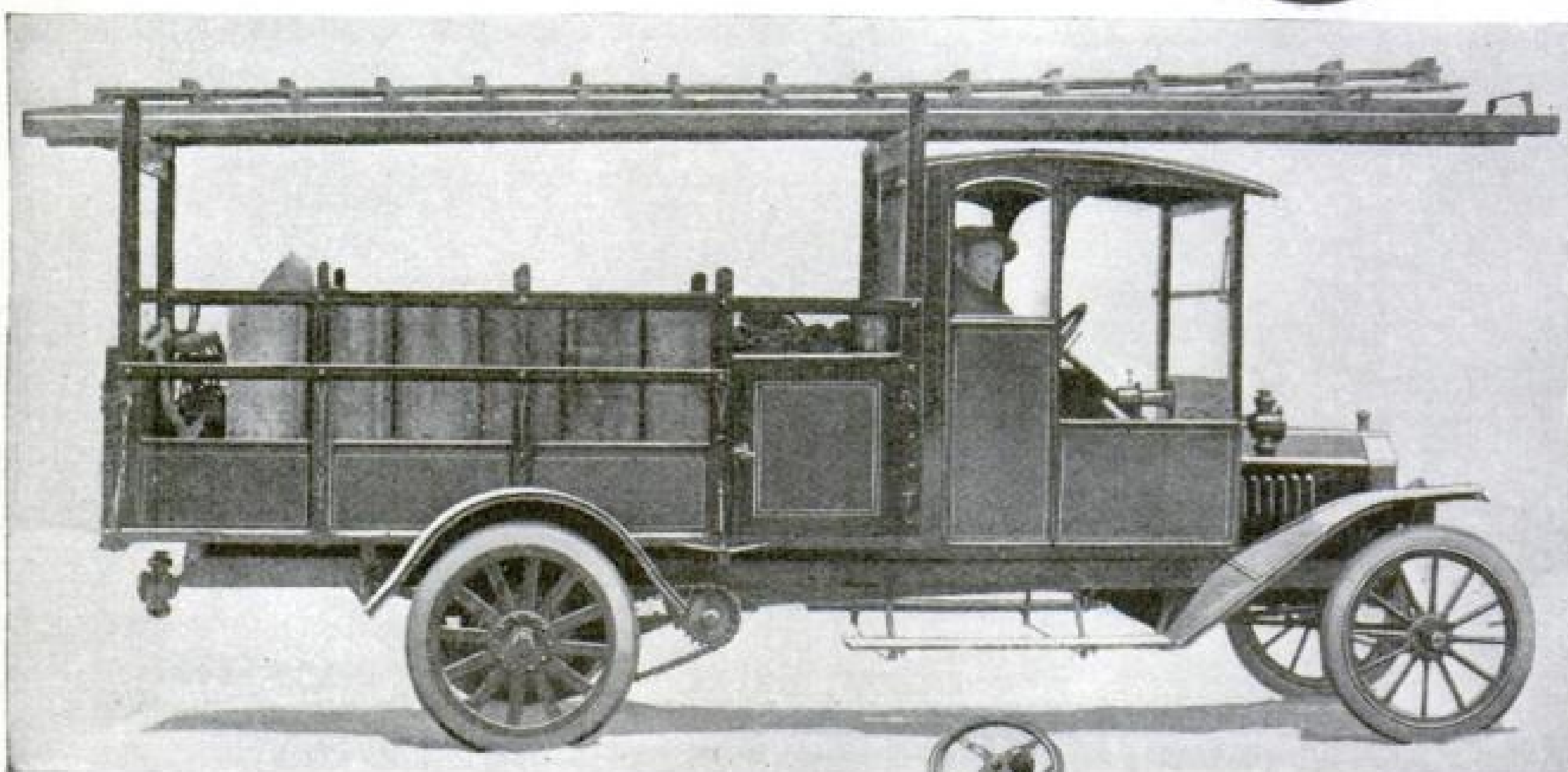
New York is the World's Luxury Market

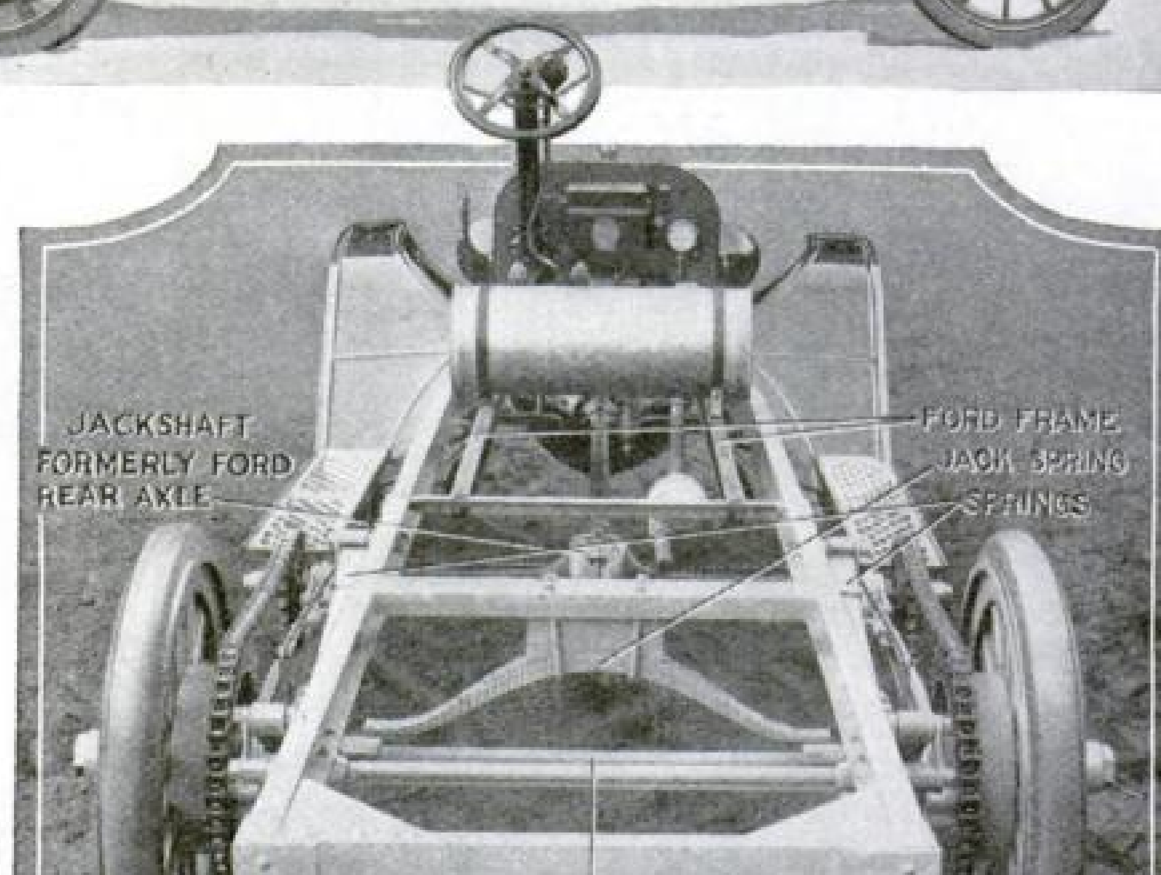
LONDON, the world's central market for the sale of luxuries of every description, has been practically closed and New York has taken its place. Custom House records show that the imports of the "luxury class" have increased enormously, particularly in the items of precious stones and works of art. As a single example, the American automobile industry's imports of crude rubber in the past year amounted to more than $111,000,000.

What Can Be Done with a Ford Chassis

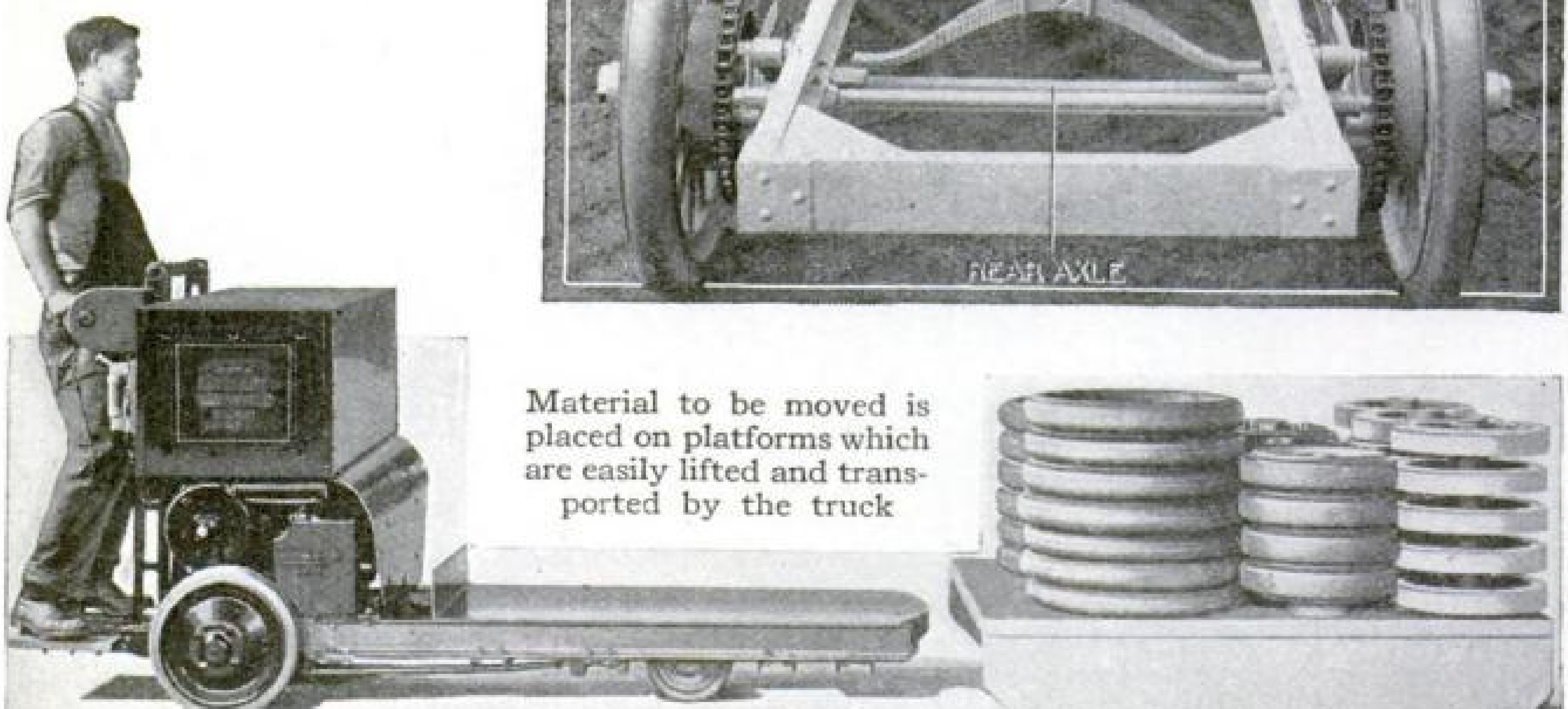


With this frame attachment the man who wants a truck of two thousand pounds capacity can readily convert a new or used Ford chassis into a truck chassis, and install it on whatever type of body will best meet his requirements





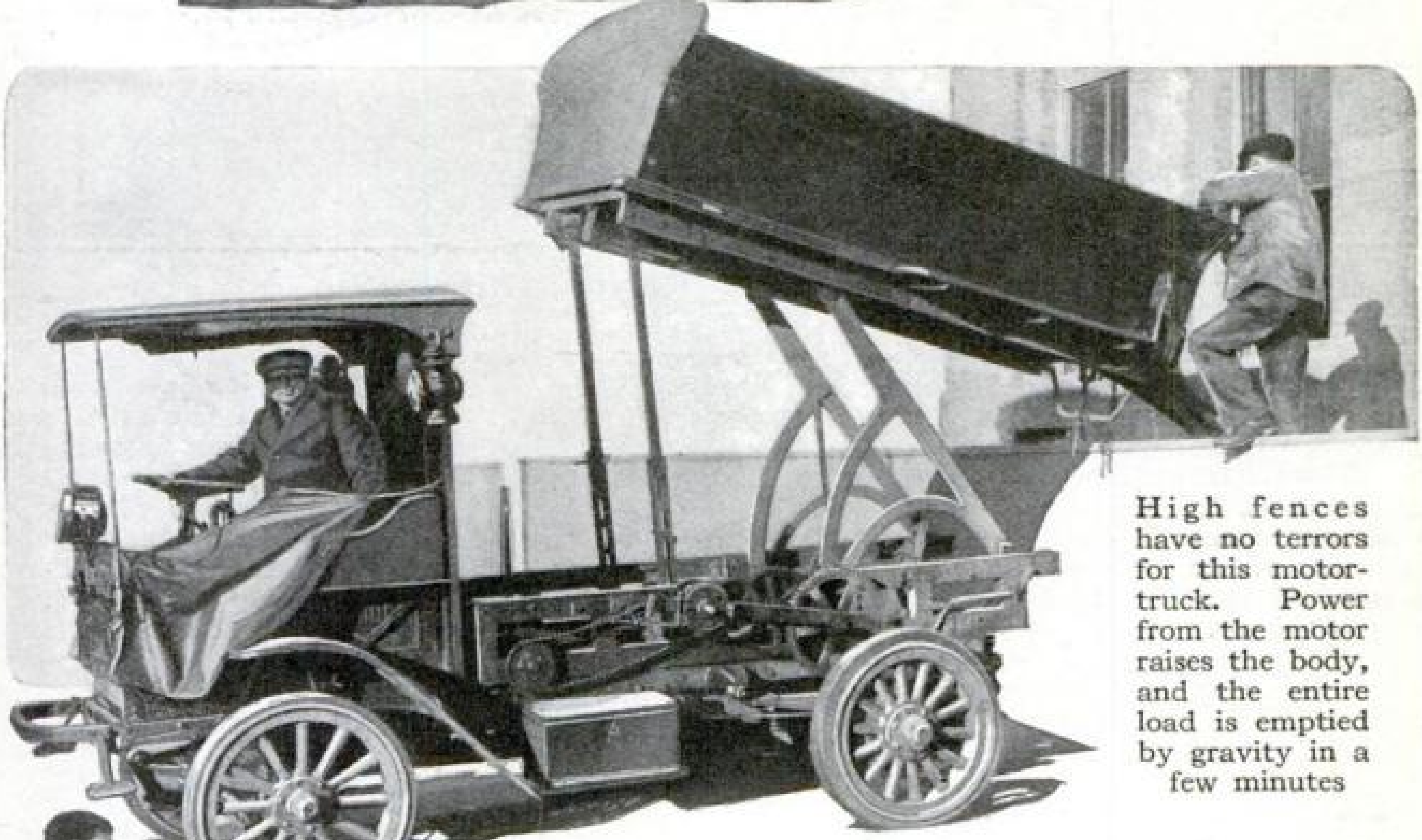
Above, when the installation is made the wheelbase is increased twenty-five inches and there is a large overhang of the frame behind the rear axle. To the right, we see how the Ford rear axle serves as a jackshaft, and how a chain-drive transmits the power to the new axle



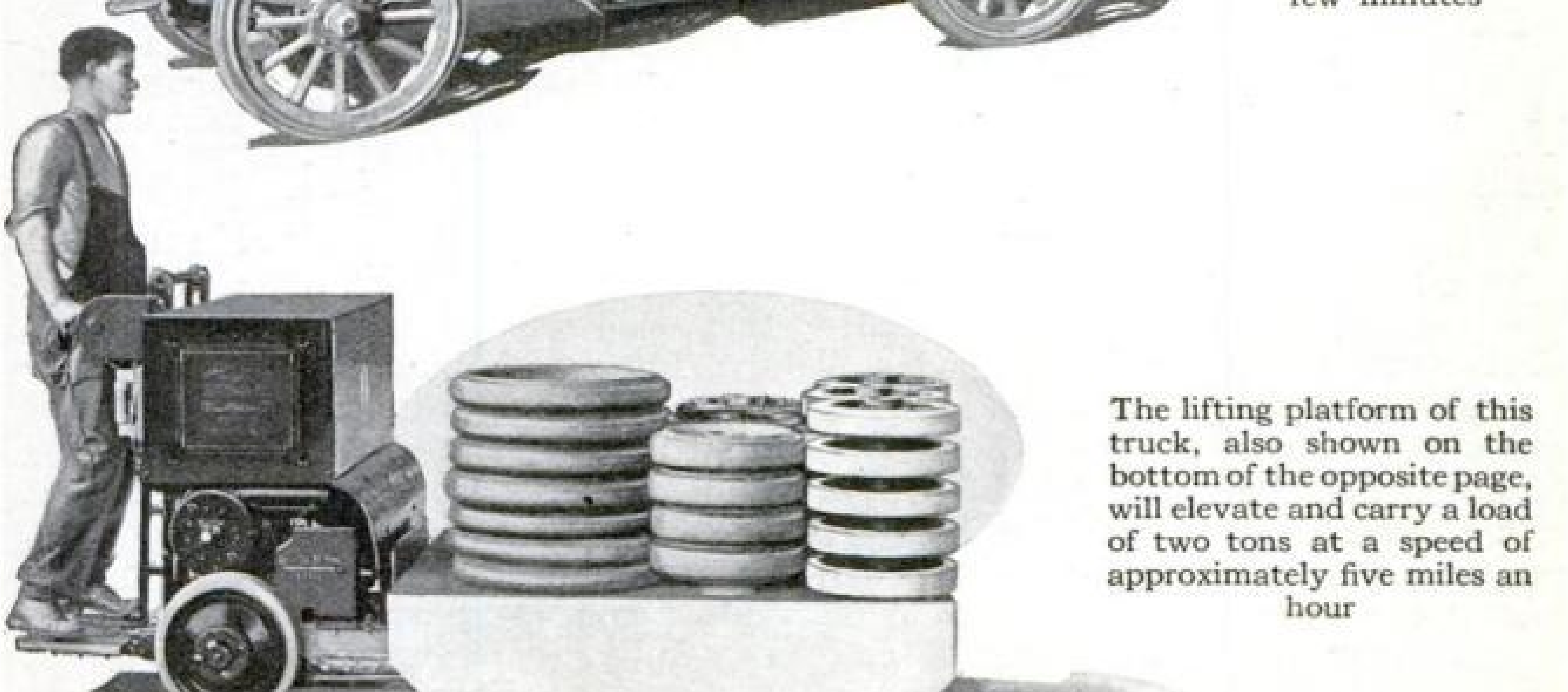
Material to be moved is placed on platforms which are easily lifted and transported by the truck

The Newest Ideas in Motor-Trucks

By dividing this body into many conveniently located compartments, the driver saves much time, and a maximum mileage is gained

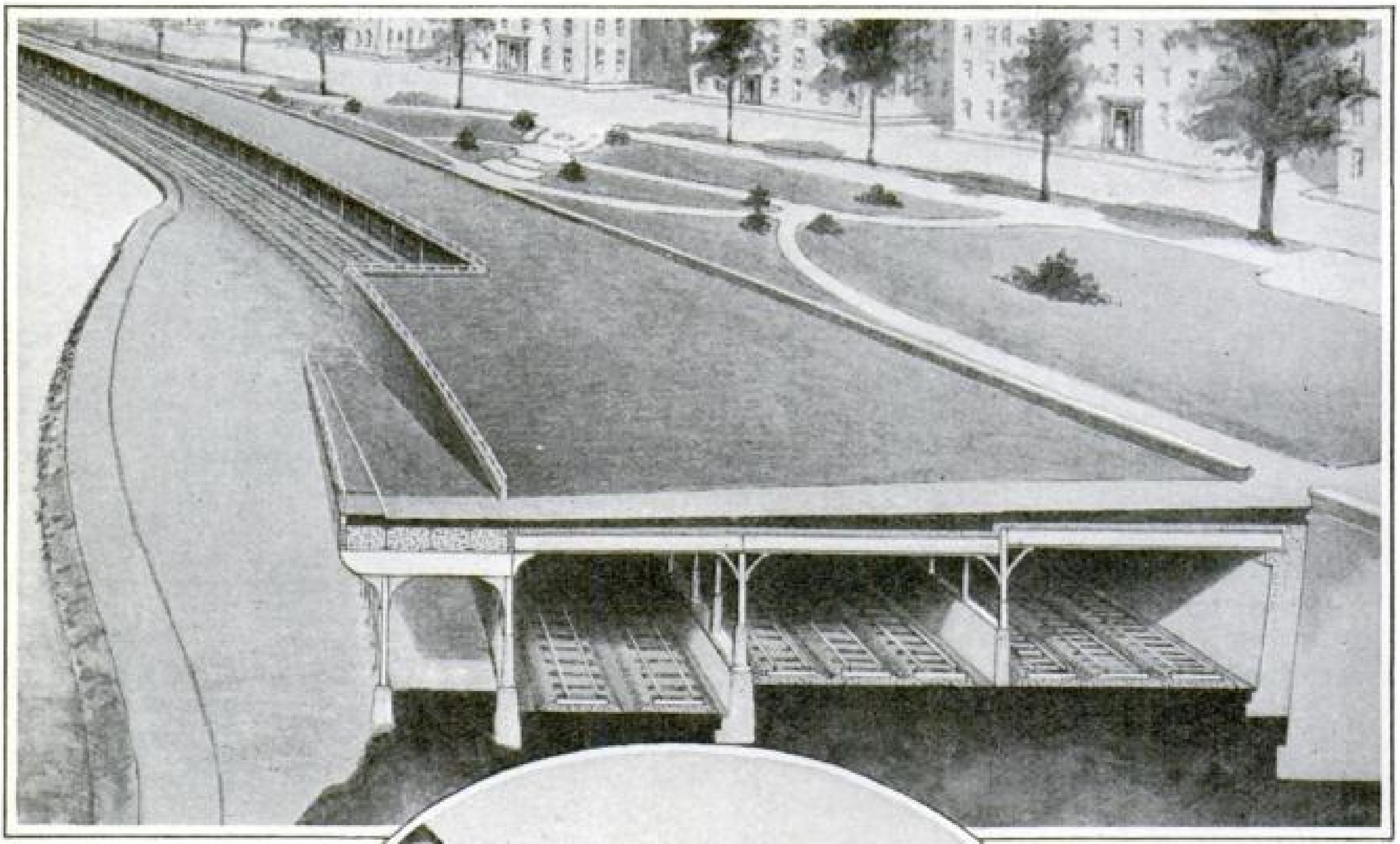


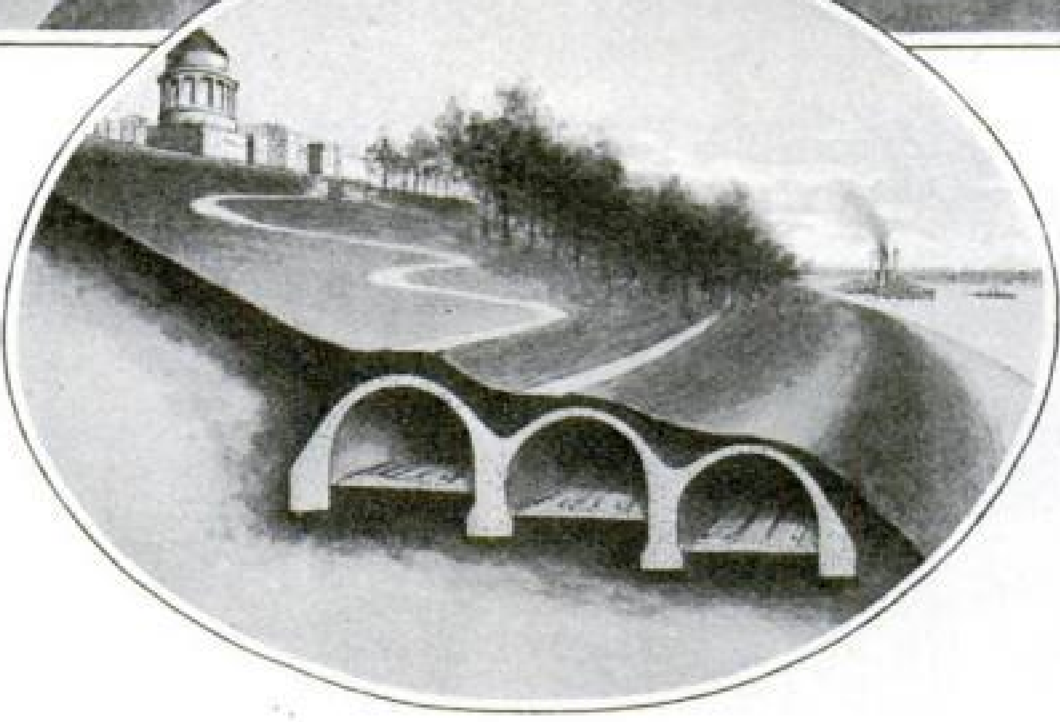
High fences have no terrors for this motor-truck. Power from the motor raises the body, and the entire load is emptied by gravity in a few minutes



The lifting platform of this truck, also shown on the bottom of the opposite page, will elevate and carry a load of two tons at a speed of approximately five miles an hour

Beautifying Manhattan's Riverfront





Where tunneling is impossible, covered subways will be provided. Paths will lead from the park proper across the subway to the river

View just north of Grant's Tomb, showing the proposed method of covering unsightly tracks and doing away with smoke and noise

THE one blot on the beauty of Riverside Drive in New York city has been the tracks of the New York Central, running along the west side of Manhattan Island. For years vigorous protests have been raised against the nuisance, one newspaper referring to the railroad's right-of-way as "Death Avenue." Recently, however, the city and railroad authorities came to an amicable understanding, with the result that Riverside Park is to be forever freed of visible railroad tracks. The tracks are to be carried in tunnel or under roofed subway, with the park development over the top and on the outshore side. This will mean permanent protection against the commercialism of the Riverside waterfront.

In the park and residential section, or above Seventy-second street, the tracks will be put under ground, and in the commercial section, below Fifty-ninth street, they will be placed on an elevated structure. This change will permanently overcome the grade-crossing evil and the city will have a parkway extending from Seventy-second street to Spuyten Duyvil, unmarred by railroad operation. In addition to this a new park at Inwood Hill, possessing natural beauties unsurpassed by any of the existing city parks, is provided. Fort Washington Park, at

present marred by an unsightly gash, is to be restored through the complete roofing of the railroad cut and the parking of the reclaimed area.

The city authorities insisted that the railroad company should turn most of its line into tunnels, and in most cases where tunnel construction is impossible on account of the slope of the land, should put the tracks in a covered subway carefully adjusted to fit in with the topography of the park. The design is such that it will allow effective parking along the entire right-of-way. As part of the settlement the railroad company agrees to pay a sum sufficient to restore the park to the edge of the river. Within the covered section of the area above Cathedral Parkway the railroad will construct a yard to take care of the business needs of the Harlem section.

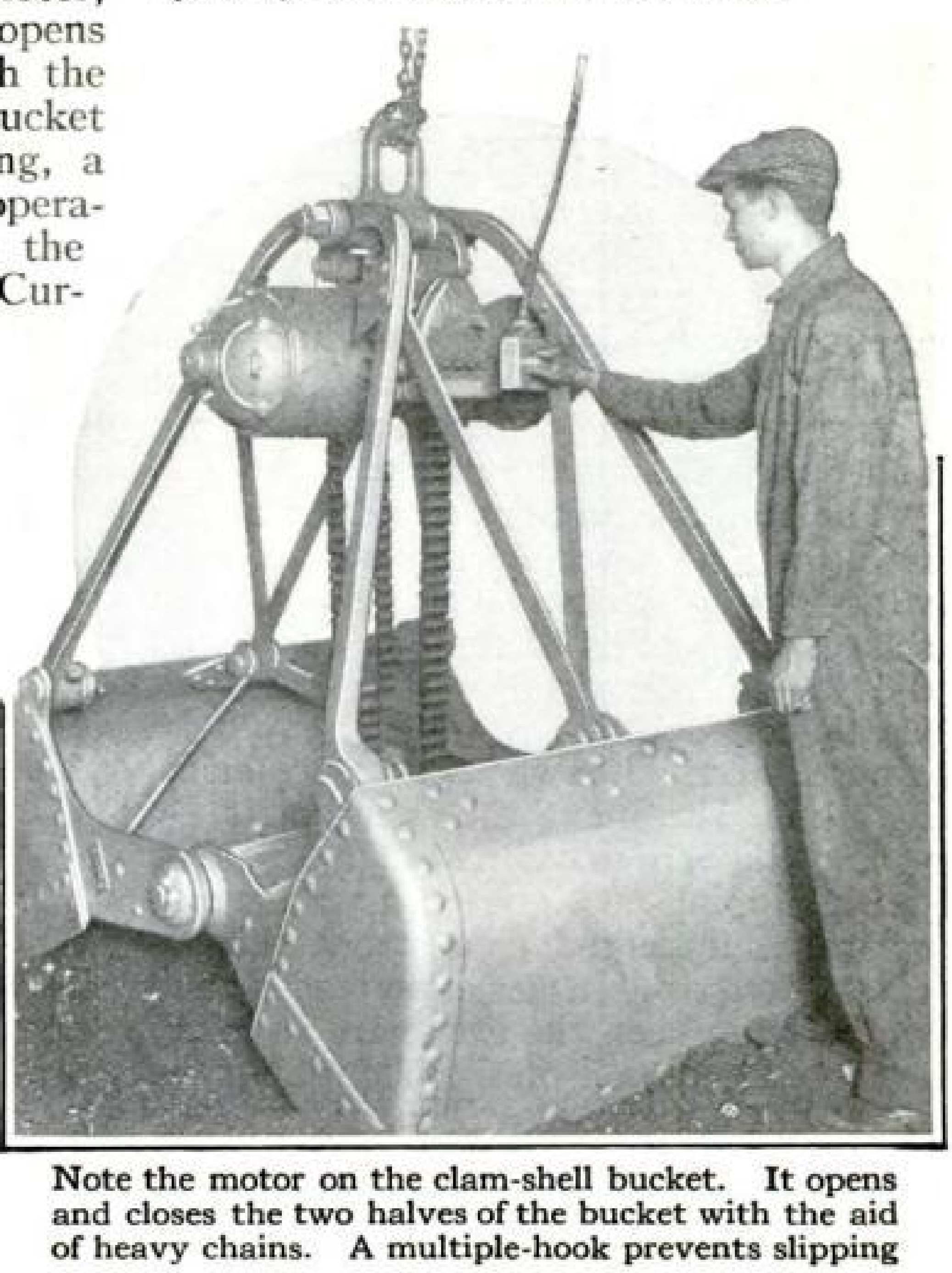
In the lower elevated section the tracks will be placed so that there will be ample room between the new line and the steamship piers to build a two-track structure for the use of other railroads later. These tracks may form part of the proposed city-built West Side terminal. It will also be possible to provide railroad connections between the elevated structure and the second stories of the proposed new steamship piers.

The improvement represents an expenditure to the railroad company of something like fifty million dollars, and the city's loan contribution averages a little more than six million. When the park system is finished Manhattan Island will offer to the visitor within her gates the most highly improved and one of the most beautiful and costly pieces of land in the world.

Electrifying the Clam-Shell Bucket

A CLAM-SHELL bucket opened and closed by an electric motor is an improvement in loading machinery now offered by a New York firm. The motor, an integral part of the bucket, opens and closes the two halves through the aid of heavy chains. Should the bucket catch on a large stone in closing, a multiple-disk clutch comes into operation, and by slipping prevents the stalling of the motor and injury. Current is supplied through the use of a heavy electric cable, which is kept out of the way and taut by the use of an automatic winding drum, situated at a convenient point on the crane, or derrick. The drum has a series of springs inside and operates like a shade-roller, at all times supplying just enough tension to keep the power wires well out of the way. A controller of simple design operated by a lever convenient to the hand of the operator regulates the amount of current supplied the motor.

The advantage of mounting a motor on the bucket lies in the greater simplicity secured. Only one block and tackle is needed, and that simply for raising and lowering the bucket. Ordinarily, additional tackle is necessary to control the opening and closing. Of course the motor dispenses with this arrangement. Another advantage is that the bucket is quickly detached from the hook.



Note the motor on the clam-shell bucket. It opens and closes the two halves of the bucket with the aid of heavy chains. A multiple-hook prevents slipping

Dipping Elk to Rid Them of Ticks

WHAT is said to have have been the first time that a herd of wild animals was dipped in an insecticide as a means of ridding them of ticks occurred at Gardiner, Montana, recently, when

After the bath the elks gave a snort and returned to their haunts, free of ticks

the Forest Service undertook to ship about sixty head of elk that had been captured in the Yellowstone National Forest to points in the Rocky Mountain and Sopris National Forests.

The herd was in poor condition as the result of a hard winter and was infested with "moose" ticks. It was feared that a large proportion of the animals would die unless the ticks were eradicated. Cattlemen doubted if the elk could be dipped, but Forest Service officials determined to make the experiment.

The elk were driven through a regular cattle dipping-pen, and each animal was entirely submerged in a strong insecticide. Less trouble was experienced than would have been the case with as many head of cattle, all of the elk taking the bath without fuss. The ticks were eradicated shortly thereafter and not a single animal showed any ill effects from the unusual experience.

Ostrich Squab: A New Delicacy

WHILE the residents of Paris, not to mention the soldiers in the trenches, are giving thanks for the opportunity to eat horse-meat now that beef, mutton and pork are so scarce, a wealthy New Yorker in quest of novelty regaled his guests at dinner recently with an ostrich squab. The diners faced the unusual treat with some reluctance, but a taste proved that broiled ostrich is by no means an unpleasant dish. Its flavor resembled that of Virginia turkey, and the guests, after the first shock of the announcement was over, ate their portion of the bird with relish and approval. The ostrich squab came from California and weighed, when dressed, about ninety pounds.

The most quizzical factor about the unusual dinner treat concerned the ultimate destination of the ostrich "left-overs," for reports agreed that the bird was not entirely devoured. Whether

Laying bare the "drum-stick"—a full-sized meal without "fixin's"

the surplus parts broke into print by way of the hotel menu under their own or borrowed names or whether they helped to make up that great international dish of mystery—hotel hash—is a question yet to be decided. At least, the first meal was a success.

Seeing the Unseen

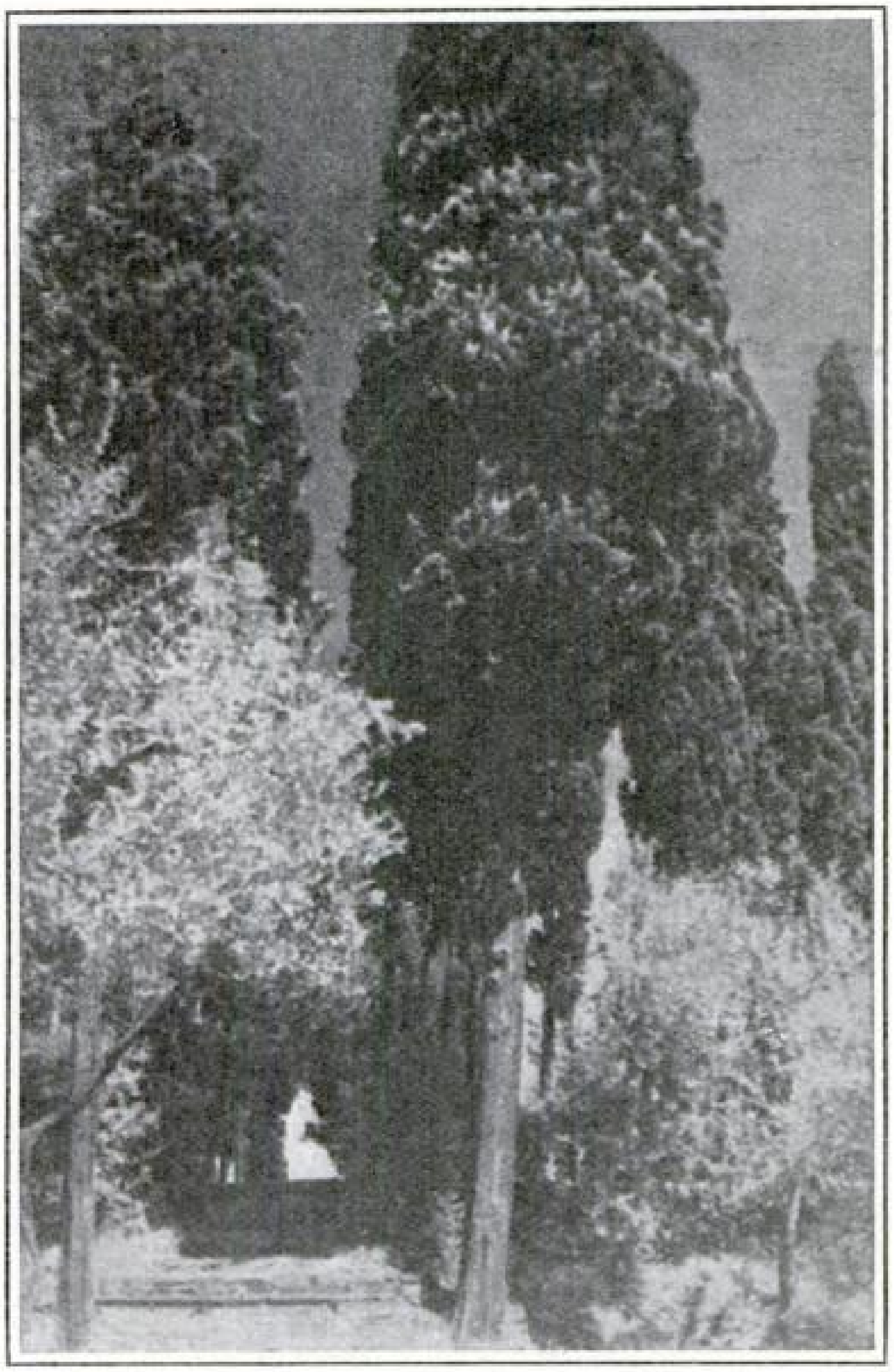
Looking at Things with Invisible Light

By R. W. Wood

Professor of Experimental Physics, John Hopkins University

Professor Wood is one of the most distinguished of American physicists. He has recently attracted attention to himself by ingeniously photographing the common objects around us, as well as the planets, with light that our eyes can never see. Thus he has opened an entirely new world, the exploration of which teems with boundless possibilities. The following article from Professor Wood's pen explains as simply as possible how he conducted his investigation and what may be seen in the strange world that our imperfect eyes can never behold.—Editor.

If you could strike all the keys of a piano at once, from the deepest base note to the topmost treble, you would create a medley or cacophony in which it would be impossible to pick out one sound from another. White light is very much like that. It is a blending of many different kinds of light.



A photograph taken with ultra-violet light reveals no shadows. White objects appear black, and everything seems veiled in a thin fog

The analogy between light and sound is closer than may be supposed, if they are regarded merely as vibrations. The characteristic that distinguishes the lowest base note from the highest treble on a piano is pitch, and pitch depends on frequency of vibration. So it is with light. Low vibrations manifest themselves as red colors; high vibrations as violet hues. Just as there is a perfect musical octave comprised of notes each having a definite pitch or frequency of vibration, so there is a light scale, manifesting itself in color notes, each also having a definite pitch or frequency. But while the frequency of the vibrations that produce musical notes is measured at the most by thousands per second, the vibrations that manifest themselves to our eyes as light must be measured by trillions per second.

There are sounds so thin and shrill, so highly pitched that only sensitive ears can hear them. Beyond them are notes that no human ear can hear at all.

The infra-red world is as strange as the ultra-violet. The sky appears black, foliage a beautiful rich red, and there are long, heavy shadows

With light it is the same. There are octaves of light which our eyes can never hope to see. Perhaps the best known of invisible rays are those used in wireless telegraphy; they are produced by vibrations of far lower frequency than those which we see as sunlight.

When you strike the middle "C" on a piano you hear a single musical note. And so, when you look at the world about you through a pane of red glass, you see things in a single light-note, as it were. Change the color of the glass and the world appears different. The same trees, the same flowers, the same houses are there, but with one color details are obscured and with another intensified.

It is perfectly possible to view the world with invisible rays and to learn things about which we never dreamed of in our philosophy—only we must use an eye, which, unlike our own eyes, will see the unknown world for us and make a picture of it which we can perceive. The ordinary photographic camera is such an eye. The sensitized plate is extraordinarily responsive to those very high-pitched vibrations that do not affect the eye. All that remains is to strike the single note in a given octave of light, with which the world is to be viewed in order to see things as they are but as we never see them.

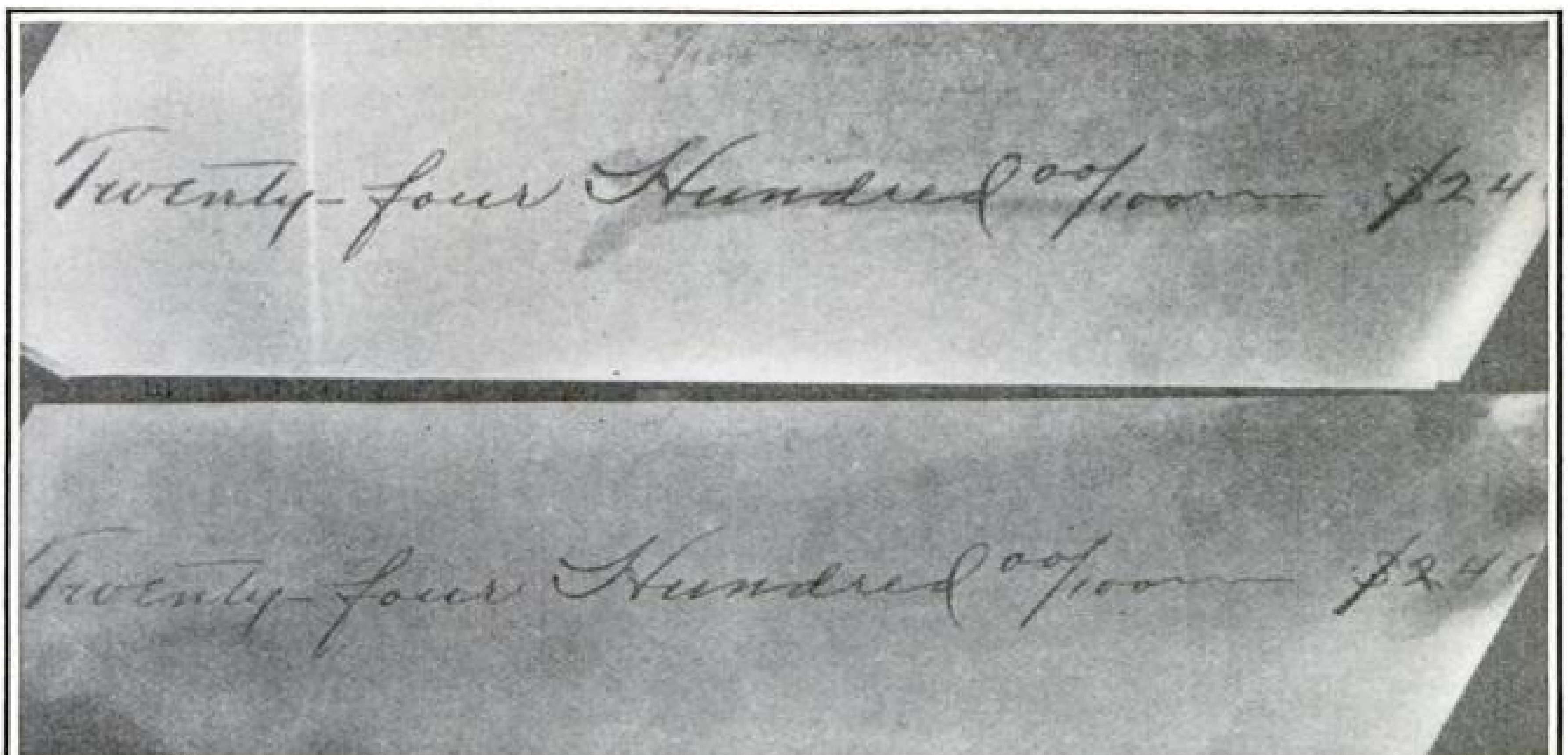
In order to see the world with invisible ultra-violet rays something better than glass must be employed; for glass is almost as opaque to them as a plate of sheet-iron. Quartz must be used, since quartz is transparent to them. Hence a quartz lens must be fashioned for the camera. To exclude all but violet rays from the lens a filter must be employed—a kind of sieve through which only the ultra-violet rays will pass, just as only red rays will pass through red glass. Some fifteen years ago I discovered that an aniline dye, called nitroso-dimethyl-aniline, would exclude all but the ultra-violet rays, the effect of which I wished to study. Thin films of silver are also serviceable, as well as the vapor of

bromine, contained in a rectangular transparent cell.

White ink made from Chinese white and written on white paper is practically invisible to our eyes. Photograph it with ultra-violet rays by means of the devices mentioned and it appears on the photograph as if it had been written with the blackest ink. Landscapes photographed by ultra-violet rays reveal no shadows. This means that the molecules of air or the particles of dust in the atmosphere completely scatter the rays, from which it follows that the greater part of the ultra-violet light that reaches the surface of the earth comes from the sky and not directly from the sun. If we saw only with ultra-violet light the world would appear as it does when a thin mist hovers over everything. We should, indeed, see the sun, but it would be very dull, and there would be no shadows, just as there are none on a foggy day. Garden flowers which are white in the sun, phlox for example, become almost black. Who knows but this ability of white flowers to absorb ultra-violet rays may play some economic part in the growth in the plant? I made some experiments to answer that question, but without success. But who knows what the result would be after several generations of plants had been grown without the influence of ultra-violet light?

It must not be supposed that there is but one ultra-violet light. There are indeed as many colors that we cannot see in the ultra-violet region as are visible in the rainbow. Unfortunately the camera and the sensitized plate do not give us true colors, as every kodak user knows; but they do indicate color differences in black and white. The photographs which I have made afford convincing evidence that there are a myriad hues in ultra-violet octaves. Thus all white flowers do not appear equally dark on ultra-violet photographs. White geraniums photograph much lighter than common white phlox.

In the opening paragraphs of this article light and sound were compared. It was stated that just as there are inaudible sounds there are invisible lights. There is a difference, however, between the sound rays and light rays. As you go below the scale of musical notes, as you lower the number of vibrations, you hear not musical notes but distinct beats or blows. That happens when there are less than sixteen vibrations in a second. But—you hear. As you go down the light scale beyond red, the vibrations decrease in number by millions in a second. But—you do not see. In other words there is but one small octave of visible light. Above and below that octave we see nothing with our eyes.



A check which was "raised" from twenty-four to twenty-four hundred dollars. The upper photograph, made with ultra-violet rays, shows the erasure plainly; the lower photograph, made by ordinary light, reveals nothing suspicious

It is obvious that the world is fully as well worth studying in light below red (infra-red) as in light above violet. When we reach the infra-red rays we are dealing with heat rays. A glass lens will answer our purpose in this case, but we must use a screen or color filter which absorbs all of the visible and ultra-violet light, while transmitting the infra-red.

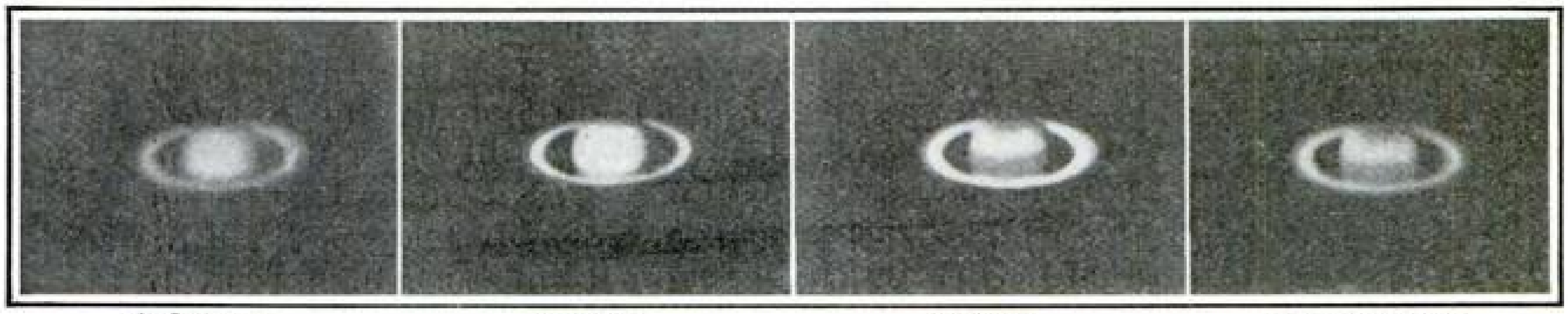
As the camera reveals it, the infra-red world is as startling as the ultra-violet world. The sky appears in photographs as black as midnight; foliage snow white. The shadows are intensely black, simply because most of the light comes directly from the sun and not from the sky.

Applied to purely scientific investigation this utilization of infra-red and ultra-violet rays has vast possibilities. I have made photographic studies of the heavenly bodies with invisible rays, and the results obtained prove convincingly that many new facts can be reached in this way.

Photograph taken with infra-red light. Note the black sky, the white trees silhouetted against it, and the deep shadows

The Moon is a dead, arid, airless body which has long ceased to interest most astronomers. Every one of its many thousand extinct craters has been plotted; its great mountain ranges have all been named; and its so-called "seas" and basins have been mapped. It seemed impossible years ago to add anything substantial to our knowledge of the Moon. I made some experiments at my summer home on Long Island with a horizontal reflecting telescope of fifty-six-foot focus and fourteen-inch aperture to ascertain what might be revealed if the Moon were photographed with ultra-violet light. While there is very little difference between ordinary photographs of the lunar surface and those made with ultra-violet radiation alone, there is enough that is significant. The brightest of all extinct lunar craters is called Aristarchus. Photographed with ultra-violet rays, Aristarchus shows a dark patch which is not to be seen on a photograph made with visible light. I made an enlargement of the region in which this crater appears, and it is evident that there is in its neighborhood a large deposit of some material which can be revealed only by ultra-violet rays. These photographs of the Moon prove that by systematically studying the lunar surface with invisible rays, we may some day discover what the Moon is made of almost with as much certainty as if we could analyze a piece of it in an earthly laboratory.

In the late autumn of last year, through the courtesy of Professor Hale, the great sixty-inch reflecting telescope of the Mount Wilson Observatory in California was placed at my disposal for four nights. The instrument is the largest of its kind in the world. Photographs of Saturn and Jupiter were made



Infra-red Yellow Violet Ultra-violet

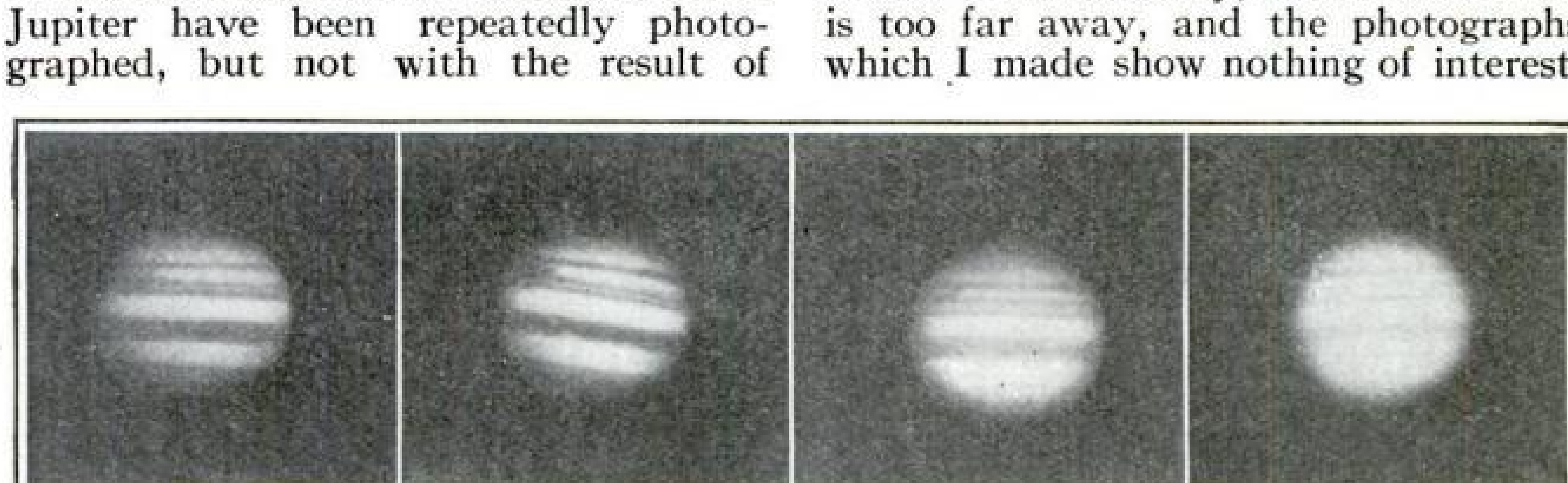
Photographs of Saturn made by Professor Wood with various rays, showing how much more is revealed by some rays than others

by means of infra-red, yellow, violet and ultra-violet light.

Both Saturn and Jupiter are striped with belts which have been the subject of much discussion among astronomers. Study the accompanying photographs and you will see how different is the aspect of the planets when photographed with different rays, whether visible yellow or invisible infra-red or ultra-violet. The belts on the ball of each planet, which can be seen with the eye in a telescope and which are very distinct on photographs made with visible yellow rays, vanish almost completely when photographed with infra-red rays. When ultra-violet light is used a remarkable transformation of the planets occurs. A broad dark equatorial belt surrounds each planet, and a large dark polar cap appears. This equatorial portion is the brightest part of each planet when photographed with visible yellow light. When ultra-violet is employed the bright belts vanish. The equatorial dark belts are still recorded, but they are slightly narrower than when photographed in violet light. Moreover the dark polar cap has decreased in size.

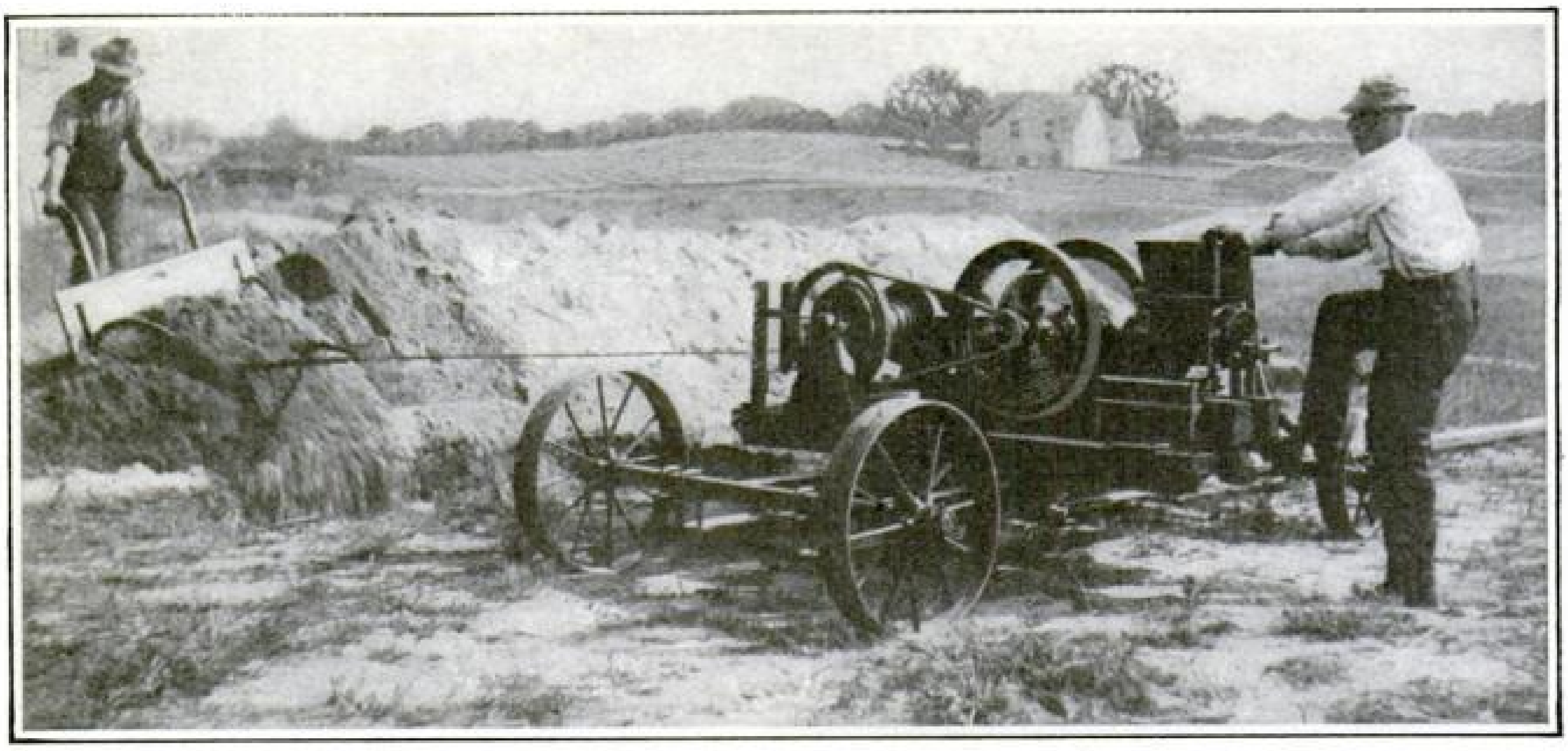
Variations in the intensity of the inner and outer ring of Saturn are also shown in the different photographs. The surface features of both Saturn and Jupiter have been repeatedly photographed, but not with the result of adding much to our knowledge. At last we have a method which may enable the astronomer to interpret the puzzling belts intelligently. It is much too early to venture an opinion. Much work remains to be done with the spectroscope. Perhaps it may turn out that the bands of Saturn may be due to some substance which has not been made in any earthly laboratory or to some substance, which has never been studied in layers thick enough to bring out the characteristic appearance. It is also possible, though hardly probable, that the belt is due to a fine mist or dust which absorbs violet light; but it seems unlikely that such a mist would appear dark for the simple reason that it would reflect equally as much light as it absorbed. As a venture we might attribute the belt to chlorine gas, which absorbs violet and ultra-violet light powerfully and is transparent to yellow light. When we recall the enormous quantity of chlorine locked up in the salt of the ocean it is perhaps possible that large quantities may exist free in the atmosphere of young planets like Jupiter and Saturn.

It seems highly probable that extremely valuable results may be obtained if these methods are applied to the planet Mars. Unfortunately, at this time Mars is too far away, and the photographs which I made show nothing of interest.



Infra-red Yellow Violet Ultra-violet

Photographs of Jupiter made by Professor Wood with different rays



Trenches are now excavated and filled by machines. The filling-machine operates the scraper at a rate of speed wholly beyond that attainable by a man and a team

Filling Trenches by Machine

AN advance step has been taken in the construction of sewers and the laying of water-mains. With the modern trench-filler no time is lost in refilling the excavation. The contents of the deepest and longest earth opening can be put back in double-quick time.

The new machine is a gasoline-engine which drives a windlass by means of which a steel cable is wound. To the end of the cable is attached a steel scraper. The engine and equipment are mounted on a movable truck. Such is the construction that the machine can be used either on the truck or can be removed entirely by simply taking several bolts out of the turntable.

The new apparatus readily adapts itself to several other uses in connection with trench operations. It is used to pull heavy cables through conduits, to raise and lower giant telephone poles into their respective places, as well as to load and unload pipe and place it in trenches.

The engine is of four and a half horse-power. It operates the scraper at the rate of one hundred and fifty feet per minute in ordinary soil and one hundred feet per minute in heavy clay. The speed is regulated to suit the soil by a change of sprockets on the engine's crankshaft.

The crew for operation consists of two men—one to pull the lever controlling the windlass and the other to handle the scraper. The instant the scraper reaches the edge of the trench the power is released, and the helper draws the empty scraper back to position ready for another load.

The Amazing Beetle

ONE of the most amazing things in natural history is the way in which beetles have triumphed in the struggle for existence. Of all creatures they are by far the most numerous, no fewer than 150,000 distinct species having been identified—three times the number of backboned animals.

Beetles are wonderfully adaptable. They are found practically everywhere—in the frost-bound tracts of Iceland and in the hot desert sands of Africa; on the highest mountains, under the ground, and as fossil, in the deepest strata; on land and in water; on plants, among stones, and in wood and earth; and even in the very craters of volcanos.

But there is one place where no beetle has yet been found—it is the inhospitable land of Spitzbergen, to the north of Russia. Here are mammals, birds, fish, mollusks, crustaceans, a few insects of varied species, and many spiders, but not a single beetle. While other insects have succeeded in some way in migrating from the mainland, the beetles have apparently been unable to cross the wide, icy waters.

Insect Carpenters and Masons

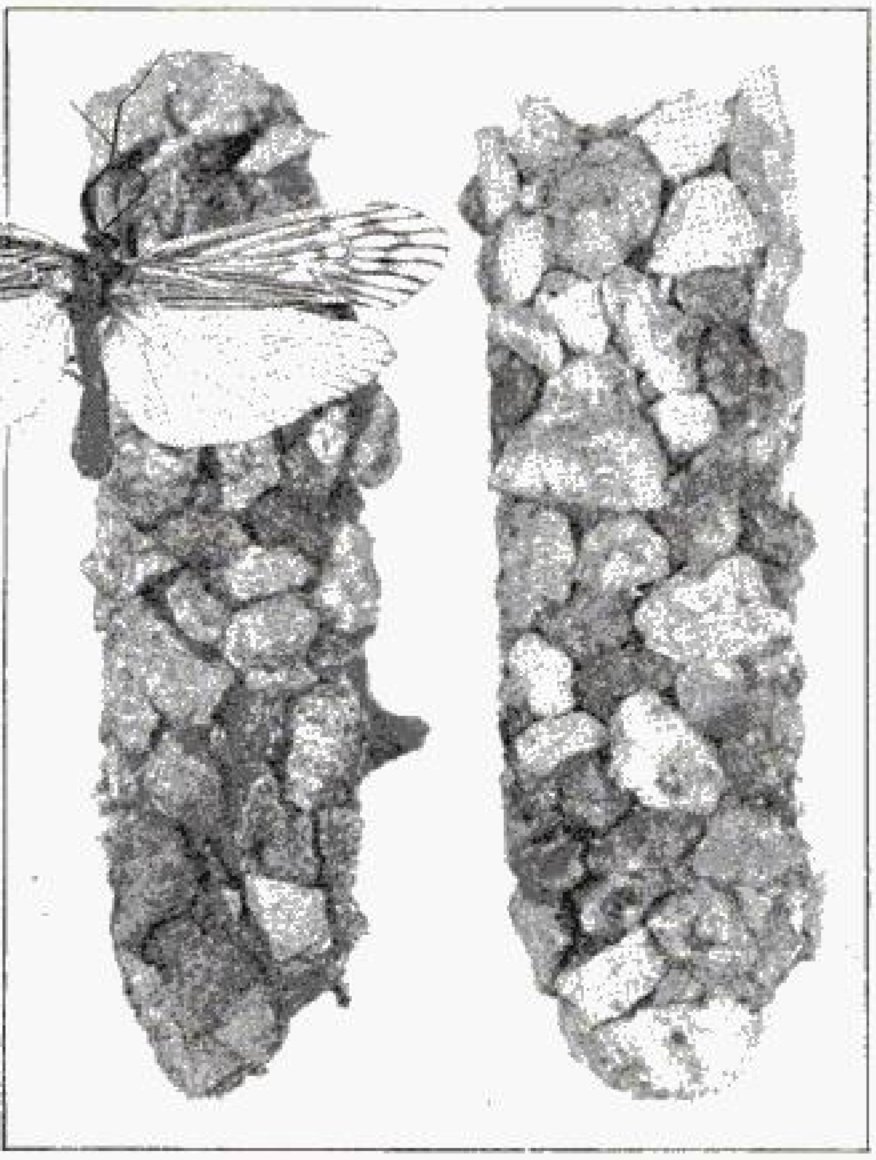
By Edward F. Bigelow

THE young naturalist who lies face downward at the brookside, and with shaded eyes watches the busy life that there has its being, will see, in many places, little masses of small stones or bundles of small sticks, moving on the bottom of quiet pools as though they were alive. When out of the water they seem to be only groups of stones or clusters of sticks, motionless and dead. But they are the homes of living larvae. By putting them in water or by pulling them apart, a whitish habitant is discovered—a larva which is a dainty morsel much relished by fish. Nature has provided it with an ingenious means of protection. The little caddis fly larva is an exemplification of the old saying that "necessity is the mother of invention," since the little animal does not always build as his ancestors built but adapts himself to the circumstances of a new environment and utilizes whatever material may be available. In some localities the cases are made of stones; in others of short twigs; in still others, some of the little builders and mechanics bore out the interior of a slender twig or straw and use the hollow as a protection against the enemy fish.

When caddis flies are placed in small aquaria they extend the body out of the front of the protecting case and carry it as they crawl. But jar the receptacle and the larva instantly retreats into its house. It is hardly possible to pull the little creature out of its case, except possibly from the smooth straw. It clings to its covering with peculiar tenacity by means of two hooks at the rear extremity of the body. So firmly is it anchored to the sticks that violence will not dislodge it, unless the force is sufficiently great to pull the insect in two.

But the larva may be driven out by using a tiny toothpick with a blunt end, or by anything else of the kind that does not terminate in a sharp point. Push this into the rear of the case and the little animal at once unhooks himself and hastens out to find a new home.

Usually the cases are straight but sometimes they are curved, and a few spiral forms have been found, which closely resemble minute snail-shells. The dweller in this rude retreat is a fisherman who not only builds a home of sand but uses the sand to make a funnel-shaped trap faced by a silken net. The funnel is directed upstream. At the entrance the net has almost rectangular meshes, often in beautiful regularity, and appears much like a delicate spider web in the water. This ingenious contrivance is placed in



Little masses of **small stones** or **clusters** of sticks, **motionless** and **dead, are** the homes **of the** caddis fly **larvae** much relished **by** fish. **These tiny** dwellings **actually** move **about as** if alive in **the water**, but show **no signs** of animation **on** dry land. **It is a difficult** matter **to induce** the **larva to** leave his safe retreat

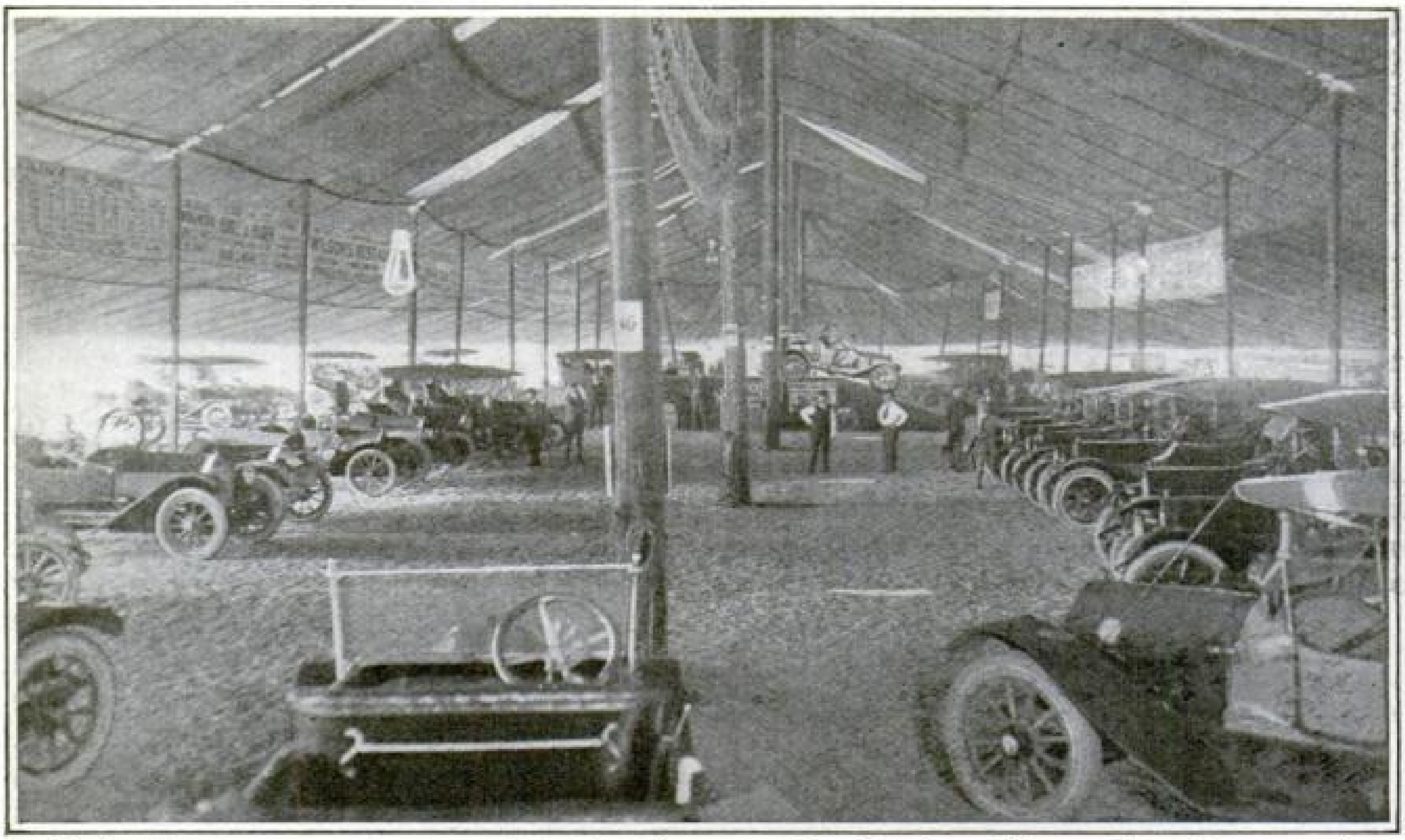
the swiftest current, and in rapids between stones. Sometimes they are found in great numbers along the brink of a waterfall. The observer must look carefully to see the net, as it is usually obscured by the dirt that collects and adheres there in little masses. But if he is so fortunate as to find one recently completed, the net-like formation is clear and beautiful.

In some places empty cases may be seen at the edge of the brook. Often they almost completely cover the rocks and the earth between them. In such instances the insects have emerged at the time of a freshet and the retreating water has left the cases stranded high and dry. The two empty cases here illustrated were obtained in this manner. They were selected from a large number because they are perfect examples of what the mason calls ashlar work, that perfect fitting together of stones without packing. Common as are the caddis worms and as often as they have been observed, not a single one has had its life history recorded in this country. A fascinating field for original investigation is here open to the first comer. Endeavor along this line is sure to be interesting.

Selling Cars Under the "Big Top"

"THE BIG TOP" is the circus man's term for the main tent with the three rings. One of these huge spreads of canvas has been taken over by a Los Angeles dealer in used cars to sell everything propelled by motors.

The tent will hold five thousand people, and it has a display capacity of five hundred cars, trucks and "jitneys." There is an oval track one eighth of a mile in circumference, and the machines go whizzing about this as if it were an indoor speedway contest. The crowd looks on from the central enclosure and judges the merits of the used cars by what they can do—not by fresh paint and varnish.

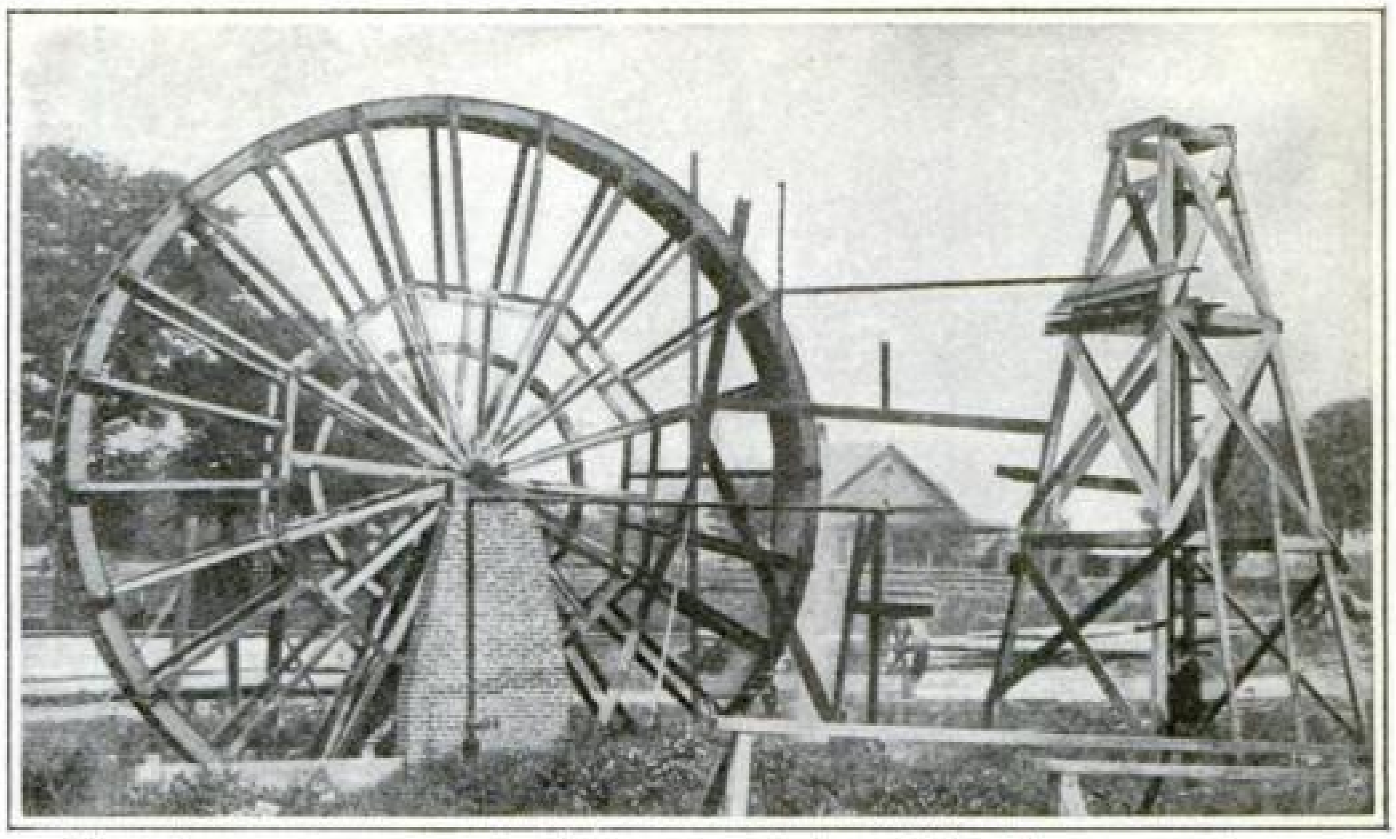


A circus-tent now used as a market-place for second-hand automobiles. A twenty per cent incline in the center demonstrates the climbing ability of the cars

An additional test is afforded by the twenty per cent incline in the center of the arena. Here the car shows what it can do on a grade. This platform is also used as an auction block for crowded twice-a-week sales. The machine whirls about the track, runs up the incline to the elevation well above the heads of the spectators, and is then knocked down to the highest bidder.

Private sales continue all through the week. A dozen salesmen are employed.

Electric Plant Run by an Artesian Well



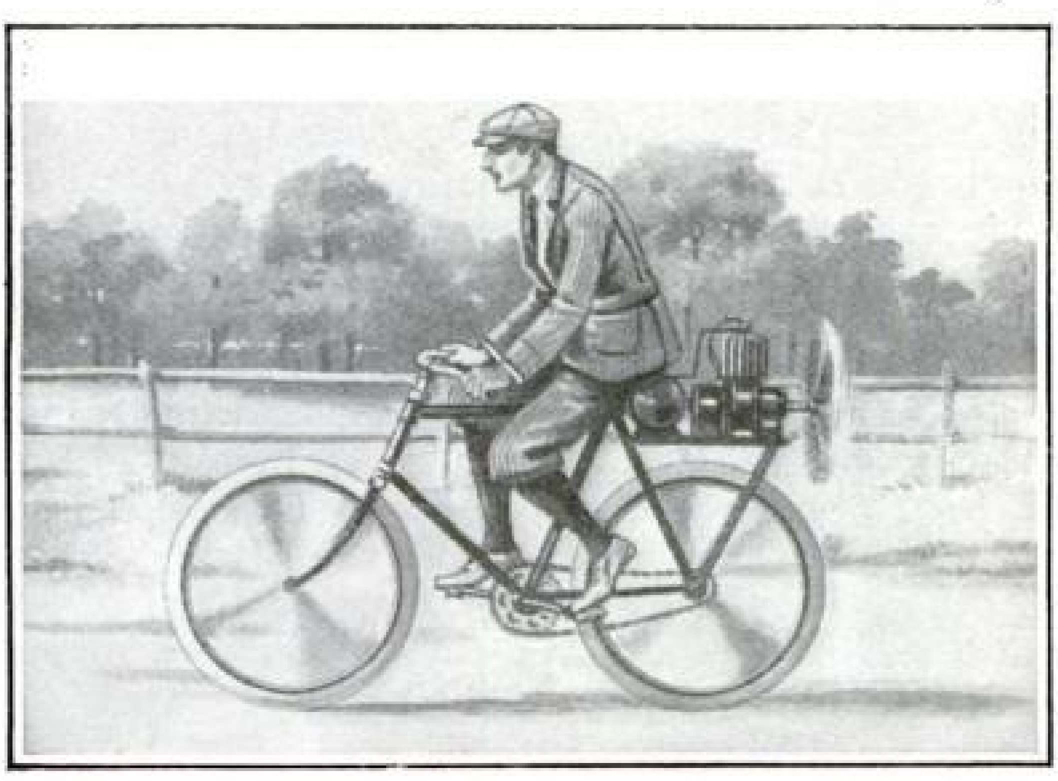
Electric current enough is generated by this plant, run by an artesian well, to operate a farm-mill, feed-chopper, lathe and other machinery used on the farm

ARTESIAN, flowing, or spouting wells are widely used for irrigation in the West, and for general water supplies in various parts of the country, but seldom is a single well made to serve such a variety of purposes as the one shown in the photograph, simply because it drives the machinery of an electric plant. The well and plant are located on a farm near Midville, Georgia. Such is the water pressure that current enough is generated to supply the house and barn with light, and power for the running of a farm mill, feed-chopper, lathe, a clothes-washer and several other labor-saving devices for the house, such as are generally operated by progressive farmers with small gasoline engine plants.

The well furnishes an ideal water supply for the farm and house, the water being piped to a submerged tank under the house, which supplies both stories on tap. The water thus does double duty. Since the supply from the well is ample, the owner is contemplating the irrigation of about an acre of garden land from a small concrete basin or reservoir into which the water can be run from the well and allowed to warm before reaching the land.

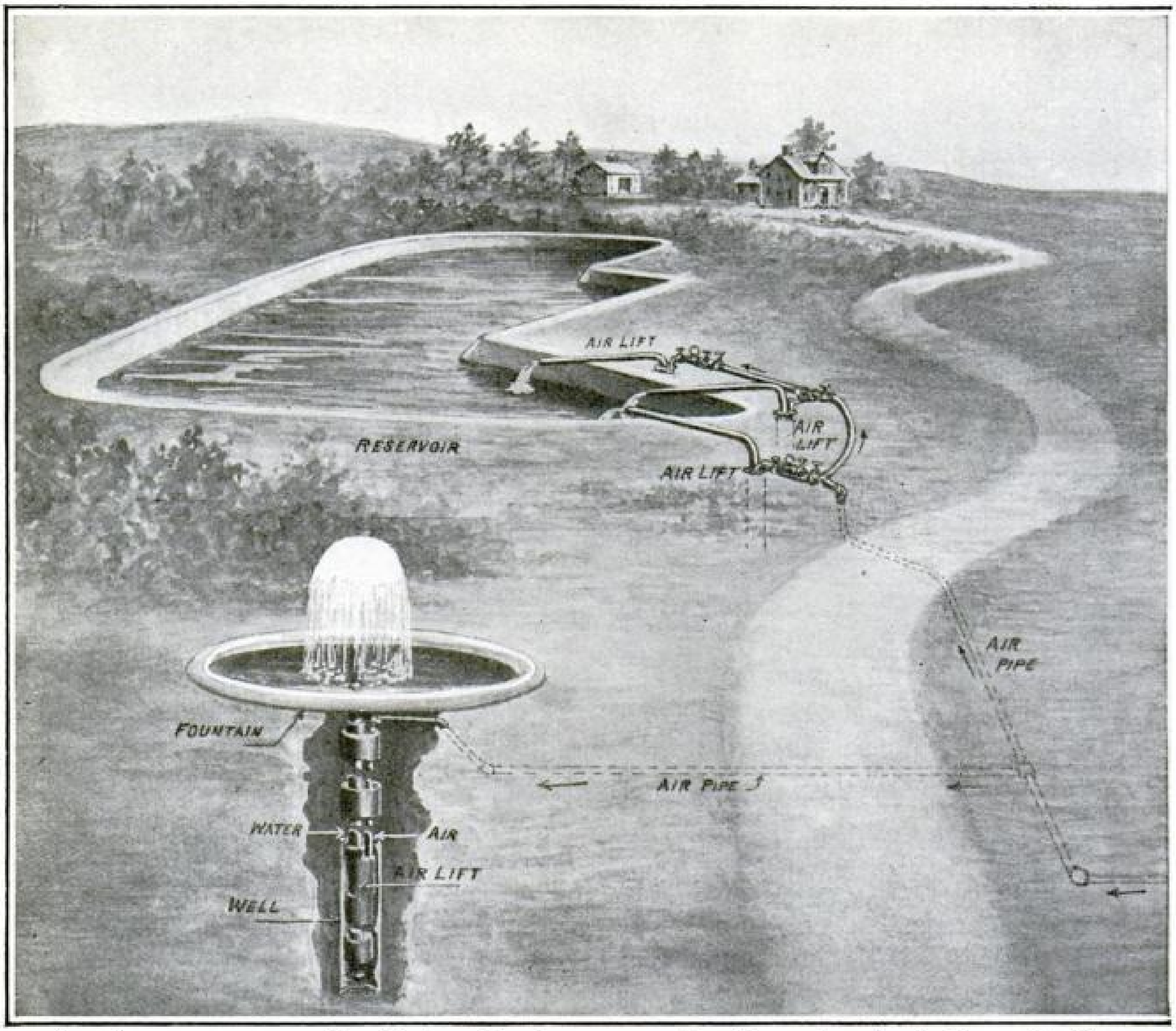
Air-Propeller Drives Bicycle

A SURE way of making the other fellow, including the motor-cyclist, take his dust, is open to the bicyclist with an air-propeller driver by a two-horsepower engine compactly mounted on a rear frame attachment. The manufacturer was so pleased with the results attained by his propeller fitted to rowboats, canoes and small, light vehicles, that he adapted his device to bicycles. It is claimed that, fitted to a four-wheeled truck known as a "motor-bob" or "wind-wagon," a speed of thirty miles an hour has been made.



With the air-propeller attachment a speed of thirty miles an hour has been attained

Since the mechanism is mounted on a rear frame there is little engine vibration. The fuel tank is situated under the saddle, and the speed is controlled by wires leading from the engine to the handlebars. A bicycle equipped with an air-propeller will afford much pleasure to the user.



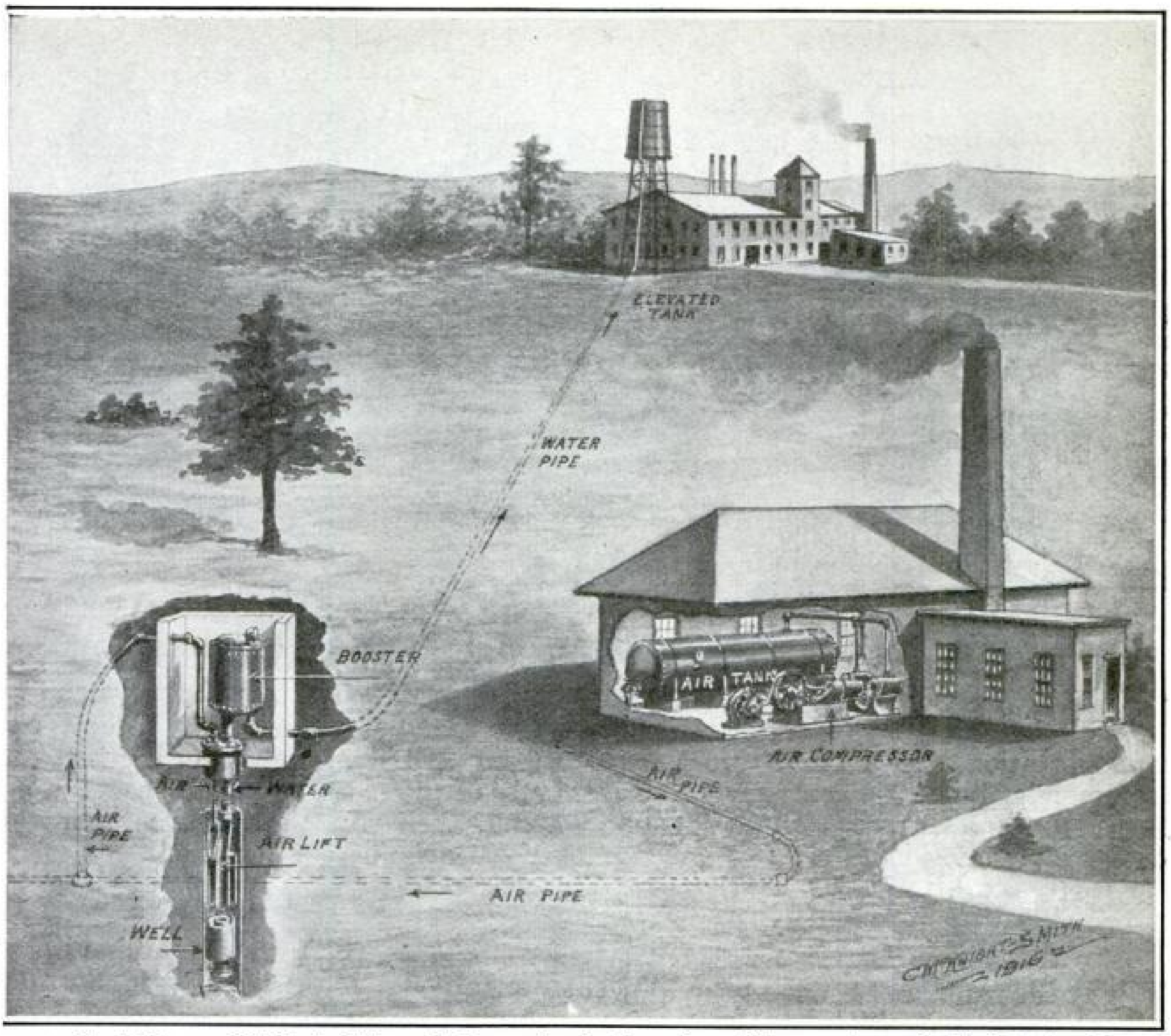
An air-compressor supplies air to a chamber surrounding the water-pipe in the well. The air passes through small perforations into the water, producing bubbles which rise slowly

Making Water Pump Itself

DOES water seek its own level? Yes, with an *if*—if the water is the same density throughout. If the density of water in two connecting vessels differs, the level of the lighter water will be higher.

There are different ways in which density can be affected. One is by heat; another is by adding to the water something that is lighter than itself—air, for instance. This can be shown in a very simple way with a tea-kettle and a short tube. Fill the kettle with water and insert the tube in its spout until it nearly touches the bottom of the spout. Then blow bubbles into the spout through the tube. The bubbles will mix with the water in the spout and lighten it. The solid water in the kettle will then overbalance the lighter aerated water in the spout; the heavier water in the kettle will force its way into the spout in an endeavor to establish equilibrium, and the spout will overflow. The water will continue to flow from the spout until the water level in the kettle becomes so low that equilibrium is established. Then the flow will cease. It is apparent that the force of the air has little to do with the action, for the air is blowing *against* the direction of flow of the water. The water really pumps itself.

Keeping the case of the kettle in mind, we will now see how it suffices to illustrate the principle of the air-lift.



and which are distributed through the water in the pipe. The greater weight of water in the well overbalances the aerated water, and is forced upward and discharged

One or more wells are sunk to a depth considerably below the level of the underground water. A pipe of large diameter open at the bottom is then sunk nearly to the bottom of each well. This is for the water discharge. When not pumping, the water in this pipe will be at the same level as that in the well. A second pipe of small diameter is also sunk to the bottom of each well, terminating in a chamber which surrounds the water-pipe. Air passes from this chamber through small perforations into the water-pipe, mixing small bubbles with the water, giving a "champagne effect." These bubbles rise very slowly, until they are distributed throughout the entire column of water in the discharge pipe. Coincident with the admission of air, the column of water elongates until it discharges.

The weight of water in the well overbalances the very much longer column of aerated water in the pipe. Thus the well-water flows into the discharge pipe, is aerated and in turn discharged.

The air pressure must be greater than the water pressure at the bottom of the well. Otherwise the water would force its way into the air-pipe and stop operations.

The water may be lifted vertically into a tank or reservoir or may be discharged into a "booster" and then carried horizontally. The booster is simply a vessel which permits the air and water to separate.

In the air-lift system there are absolutely no working parts, such as pistons, valves, etc., under ground, which are liable to wear, to rust, or to become defective with use. Air is supplied by an air-compressor, which may be located far from the wells, if desired.

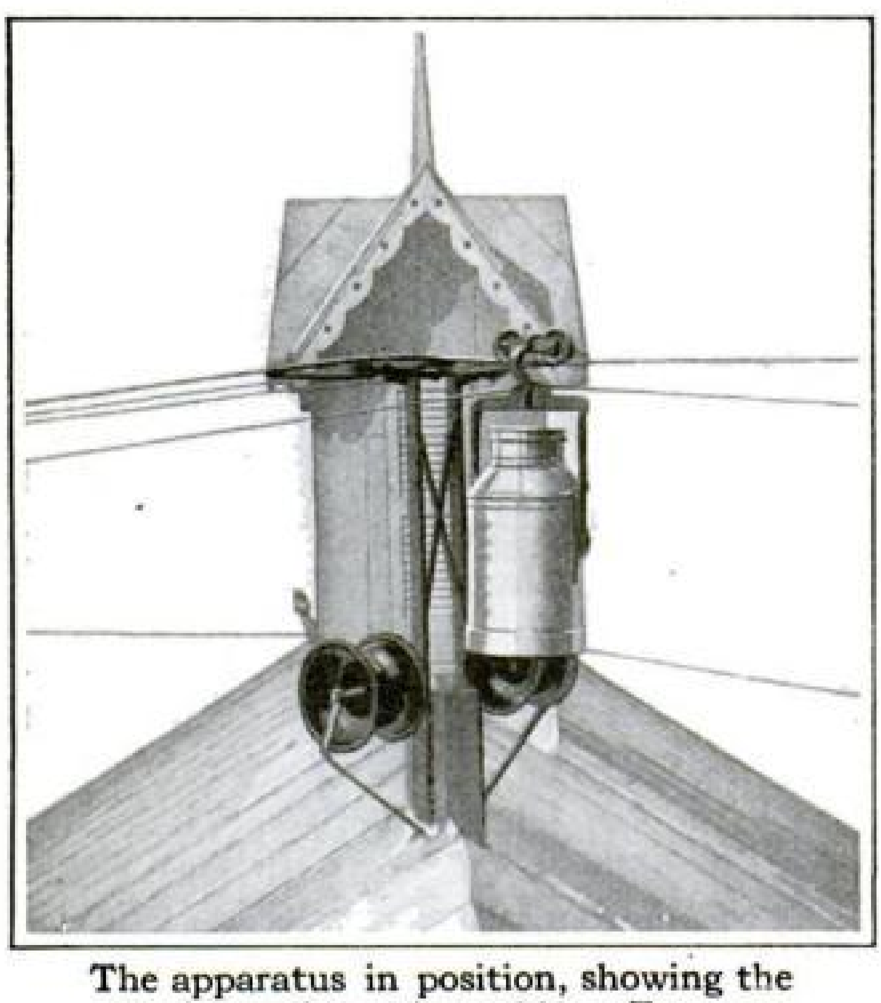
Everything was there but the engine and they substituted a burro for that

A "Jackomobile" for Two

THE illustration shows a combination of the oldest and newest means of transportation. In 1904 it was a new automobile, but in subsequent years it fared so hard at the hands of one owner after another that its engine was discarded and the machine itself was on the way to the dump heap when two boys assumed ownership. They obtained a burro and after fitting the body of the old model with shafts, went about their Michigan town with the only "Jackomobile" extant.

The Milk-Can Trolley

FOR the rapid and economic handling of milk a Western creamery has installed an aerial tramway, six hundred feet long, leading from its milking barns direct to the refrigerating and bottling plants. The milk travels over the top of stables en route, and a complete trip of one five-gallon can on a two-wheeled carrier takes but seventy-five seconds. Formerly this work was done by a driver with team and wagon. The tramway has taken their place.



The apparatus in position, showing the carrying and traction cables. Two cans are always in transit

There are always two cans in transit at the same time, one coming in full and one returning empty. The attaching links are so spaced that when the full can has reached the end of its trip at the bottling house, the empty can has also reached its destination at the milking barn and stops at the proper place, automatically. The drag-cable is driven by a reversible set of small drums having grooves to receive the cable. Signals to start are given from the barn by a magneto bell.

For dairies which handle large quantities of milk and make express shipments to large cities, this conveyor is a great step in advance, since it reduces the time required in handling the milk.

Straw Raincoats of Japan

THERE are as many different kinds of alleged waterproof raiment in existence as there are straws in the grotesque costume of the Japanese in the accompanying illustration. But there is just one raincoat which lives up to its rainproof claims, and, in fact, has lived up to them for a thousand years and more, and that is the rice-straw combination worn by the Nippon.

In addition to being light, porous and warm in cold, wet weather it serves as a "blind" for the wary fish which can discern no danger lurking in a fishing-pole protruding from what appears to be a mere sheath of grass. A Nippon angler seated on a river bank wearing his rice-straw cloak resembles so closely a tuft of rank grass or a growing scrub that the most preyed-upon animals fail to detect danger.

From the score of waterproof materials and impervious clothing there is a new Paris product which is said to be very effective, providing one doesn't approach too close to the fire. It is highly inflammable on chance ignition, since its inner lining is composed of guncotton sheeting. There is also an English raincoat which weighs but nine pounds when dry, but which, when worn through rain, will absorb water as readily as a sponge. In an hour it has been known to absorb six pounds of water, adding greatly to its weight and accelerating physical exhaustion. Yes, it's waterproof.

What? Only Three Kinds of Feet?

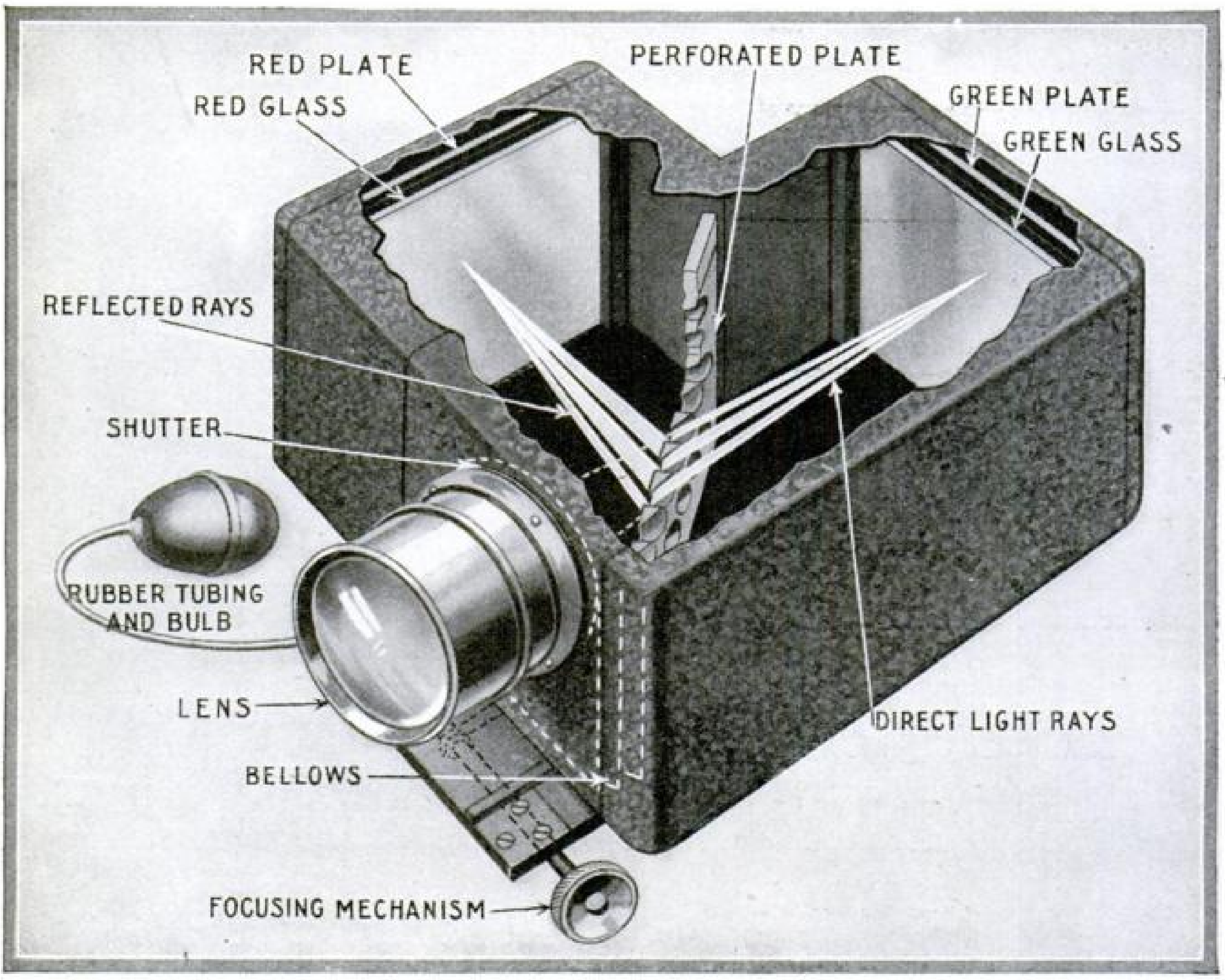
A RECENT meeting of foot doctors brought forth the information that all feet are divided into three classes, namely, inflared, outflared and straight—the first two classes being scientific divisions for the common afflictions known as pigeon-toes and bow-legs. One doctor said: "Shoes are proverbially made to fit the eye and the pocketbook, but not the feet." In other words the manufacturers have not kept step with the times by making shoes of three classes.

The ordinary classification of boots, shoes and slippers does not fit with the inflared, outflared and straight classes of feet, stated the doctors, as was proved by the fact that most manufacturers ride in automobiles. To remedy the situation it is proposed that all shoes be manufactured to conform with the three general classes of feet, that both feet and shoes may advance side by side in the scale of civilization.

The rice-straw cloak on this Japanese is the oldest as well as the most effective of all the various kinds of waterproof clothing extant

Photography in Natural Colors

By Lloyd Darling



The Brewster camera, showing the red plate, the green plate, and the perforated partition

COLOR photography is not new. It has been the goal of ambitious inventors ever since scientists really understood something of the nature of light. Nearly all methods of making colored photographs are long and expensive. Though beautiful results were in some cases secured, only an able scientist could manipulate the apparatus, time the exposures, and keep track of the dozens of little things all-essential to securing satisfactory results. Even the Lumière process, widely employed as it is, is handicapped by the fact that the pictures must be viewed through glass.

Most of the previous processes were of the "three-color" type. That is, they depended on the fact that from three colors of the spectrum, red, yellow-green, and blue-violet, all other hues could be made by combination. Negatives of an object were made through red, yellow, and blue filters, and positives therefrom were colored and joined in various ways to make a resultant colored picture.

Within recent years encouraging experiments have been made which involve the use of two colors only, red and green. The most recent system of color photography dependant on this method is that of Mr. Percy D. Brewster of New York.

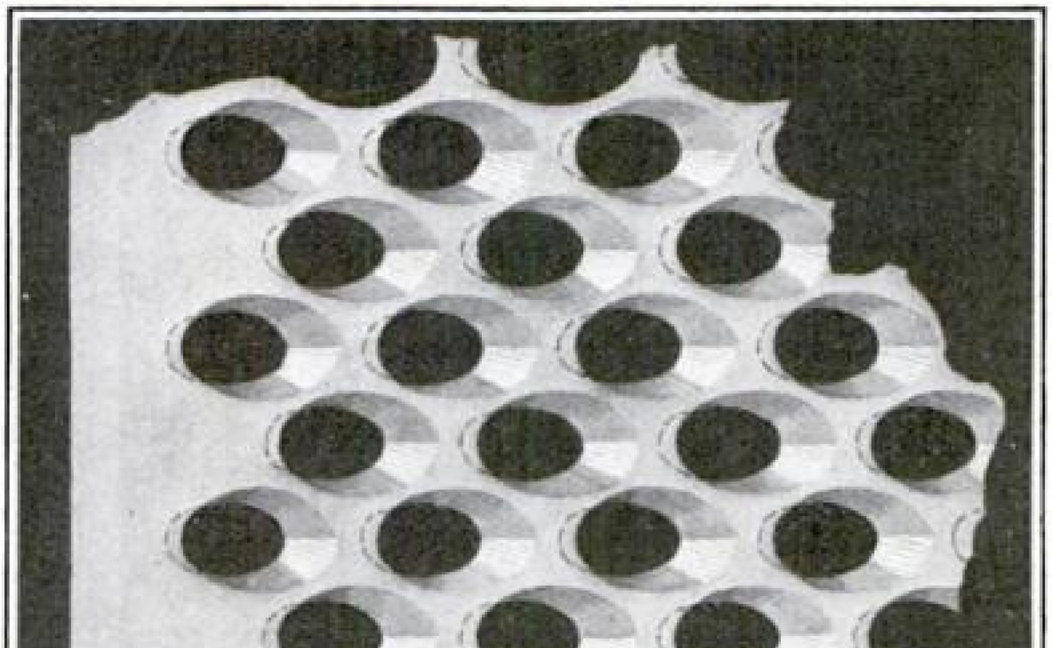
Two Plates Are Used with the Camera

The camera employed in the Brewster system and other two-color systems differs from the ordinary photographer's mainly in that it has two plates instead of the customary one. The one

directly back of the lens is known as the "green" plate; while the other at right angles is referred to as "red." This arises from the fact that light rays reaching the "green" plate must first pass through a green filter, while those falling on the "red" plate are correspondingly filtered by a red glass. The "green" plate is intended to record at the green portion of the spectrum, while the "red" is sensitive to those at the opposite end.

The manner in which the image is conveyed to both plates is interesting. Thus, Mr. Brewster mounts, a few inches back of the camera shutter, a mirror called the "Swiss Cheese" plate, its surface being at a 45° angle with the plane of the lens. The mirror is thus strangely named because it is full of holes, which serve to permit parts of the image to pass through to the "green" plate; the remainder being reflected by the solid part to the "red" plate. Inasmuch as images filtering through the holes overlap after passing the mirror, a complete picture is thrown on the "green" plate—and not a spotted one, as might be expected because of the holes. Likewise the solid portion throws a complete image on the "red" plate. Dividing the light between the two plates in this manner of course lengthens somewhat the time of exposure necessary; otherwise no other effects are ordinarily noticeable.

The same effect can be obtained in many other ways. Thus, in what is known as the "kodachrome" process a plate is employed which, instead of being perforated with Swiss cheese holes, is thinly platinized, so that it can both reflect and transmit light.



The "Swiss cheese" mirror. The dotted lines indicate the size of the holes on the reverse side

It is understood of course that negatives obtained with the Brewster, "Kodachrome," and similar instruments are of the ordinary black-and-white variety —not colored in any way. The "green" plate differs from the ordinary negative only in the fact that it is especially dense where colors at the green end of the spectrum predominated, while the "red" plate likewise records densely roseate hues. From these two negatives positives are made on other plates by ordinary processes of contact printing. The image on the positive from the "green" plate is dyed red and that from the "red" plate green. The two positives are then placed face to face, and the image on one registered with the image on the other.

Hold the combined plates up to the light, and you can see the photographed object in its natural colors. It stands out from the background as striking as the original. The effect is startling, indeed.

Why Two Colors Must Be Employed

The reason for coloring the "green" positive red, and the "red" positive green, as mentioned in the foregoing, is rather elusive and at the same time particularly interesting. Consider for instance the case of a red rose on a background of green leaves. The "green" negative upon development will be almost black where the green leaves appear on the plate, while the rose will be almost transparent. Similarly with the "red" negative, the rose will appear dense, while the green is recorded as a transparent area.

Positives from these two plates will in each case of course be just the opposite

of the negatives. That is, a positive from the green plate will show the leaves transparent, and the rose dense; while that from the "red" plate will show the leaves dense, and the rose transparent. Dyes used in this process affect only the dense places. It is obvious that if you want a red rose to be red in the resultant picture, you will have to color the positive from the "green" negative red, that being the only one showing the red rose as a dense area. Similarly, you will have to color the positive from the green negative "red," since in this case the leaves are dense. After dyeing them in this manner, the plates pass through a special process to eliminate the opaque black silver on the plates, leaving only the colored images. This process completed, the two plates are placed face to face and registered properly. Then you see the red rose in its proper place among the green leaves.

The next step is to cement these two positive emulsions together. This done, they are stripped from the glass and transferred to paper, canvas, ivory (in the case of a miniature), or any other backing. In their new positions they look not unlike an oil painting, especially when canvas is used as a mount.

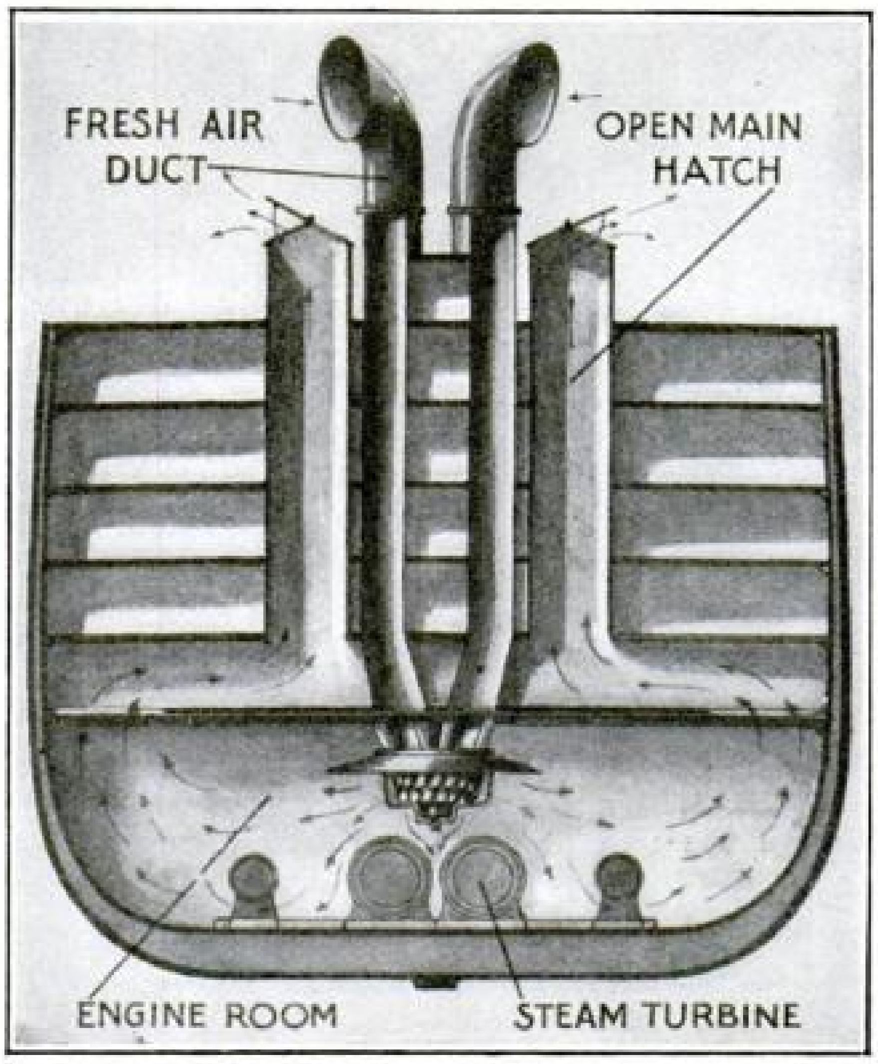
For the sake of simplicity, the foregoing description of the red rose and green background referred only to these two colors. It is understood of course that almost any color which may have been present in the original object also appears in the finished picture. This is possible because red and green combined in different proportions by the process here used will give such desired colors.

How a Steamer's Engine-Room Is Ventilated

PHYSIOLOGISTS have shown in recent years that the chief effect of ventilation and open air treatment depends on the movement, temperature and moisture of the air, and less upon its chemical properties than was expected. For this reason the cooling of overheated engine-rooms, underground or underdeck, is best obtained, as engineers have discovered, by flooding them with fresh air from outside under slight pressure. This positive ventilation or a continuous change of air also removes all noxious gases and smells emanating from the oil and bilges.

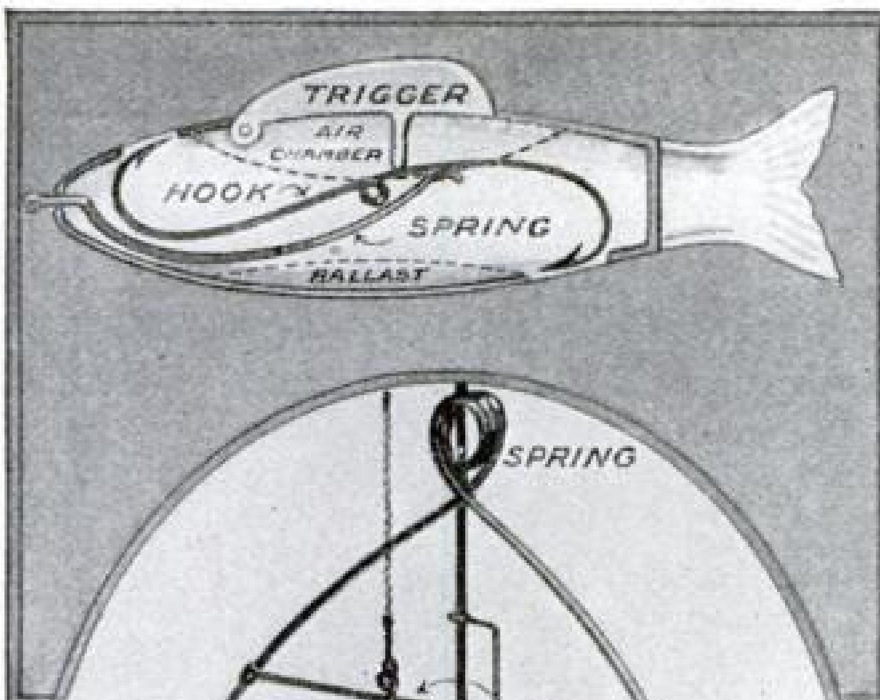
The accompanying drawing shows a transverse sectional view of the engine-room of the "Aquitania," with the recommended method for flooding the confined space with cool, fresh air under moderate pressure. The air is delivered into the engine-room by a large open fan placed at the junction of the lower ends of the air-shafts, so that the full volume of fresh air, equal in this instance to about one hundred and fifty thousand cubic feet per minute, is propelled into and properly distributed through the engine-room without loss from delivery ducts.

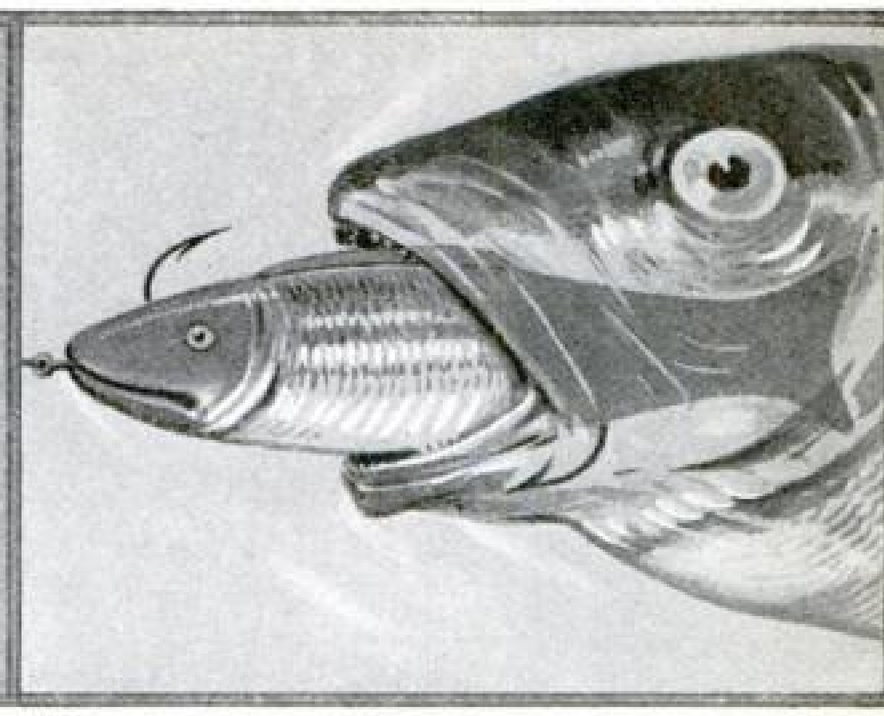
When desirable, the air in the engine-room may be changed one hundred and twenty times an hour without uncomfortable drafts. The cool air is drawn, not forced, down from the upper deck and delivered laterally by open fans placed low down in the engine-room so as to flood the whole space with air, the cooler incoming air falling towards the floor, displacing the heated air and expelling it up the main hatch. Many transatlantic liners have the ventilating system illustrated.



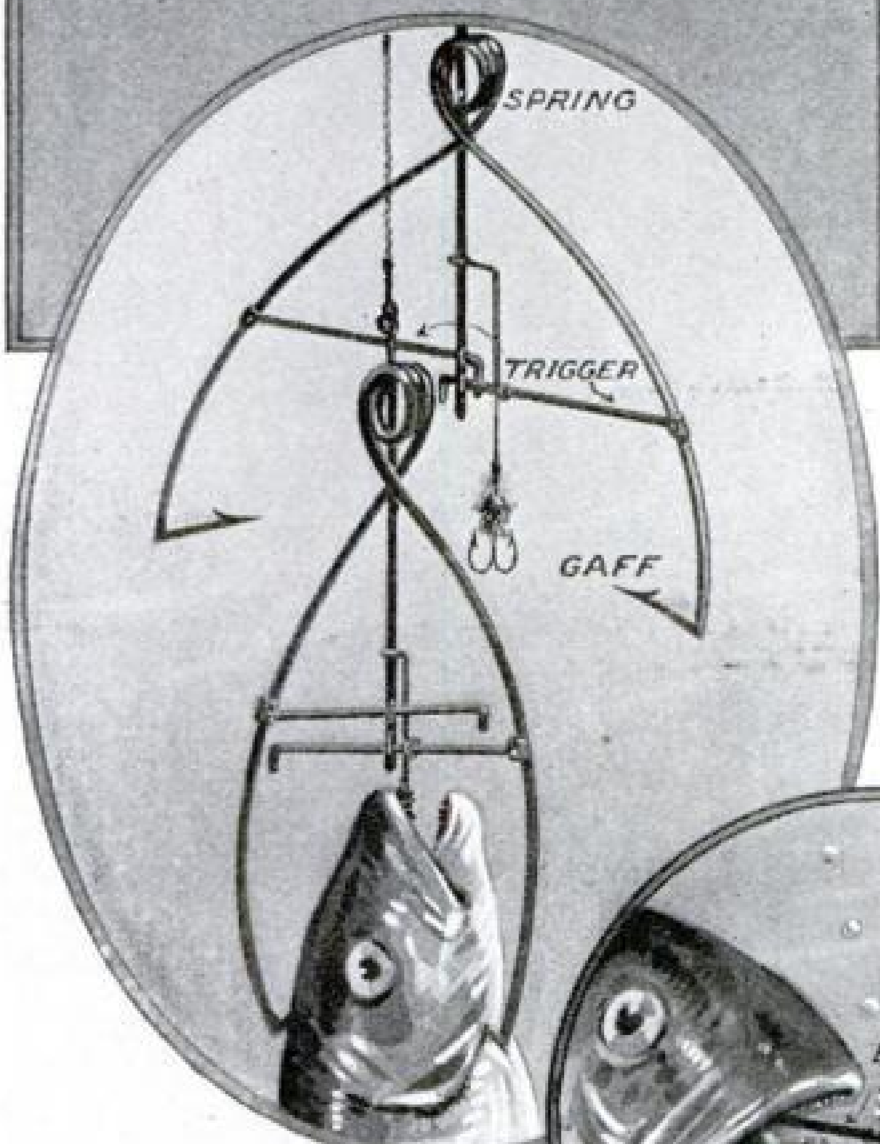
A cross-section view of the "Aquitania," showing ventilating arrangement

What Inventors Are Doing for the Fisherman

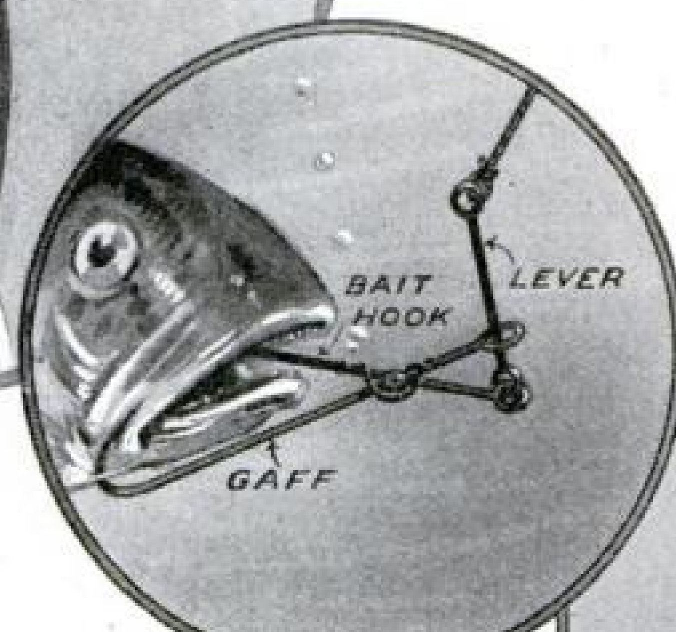




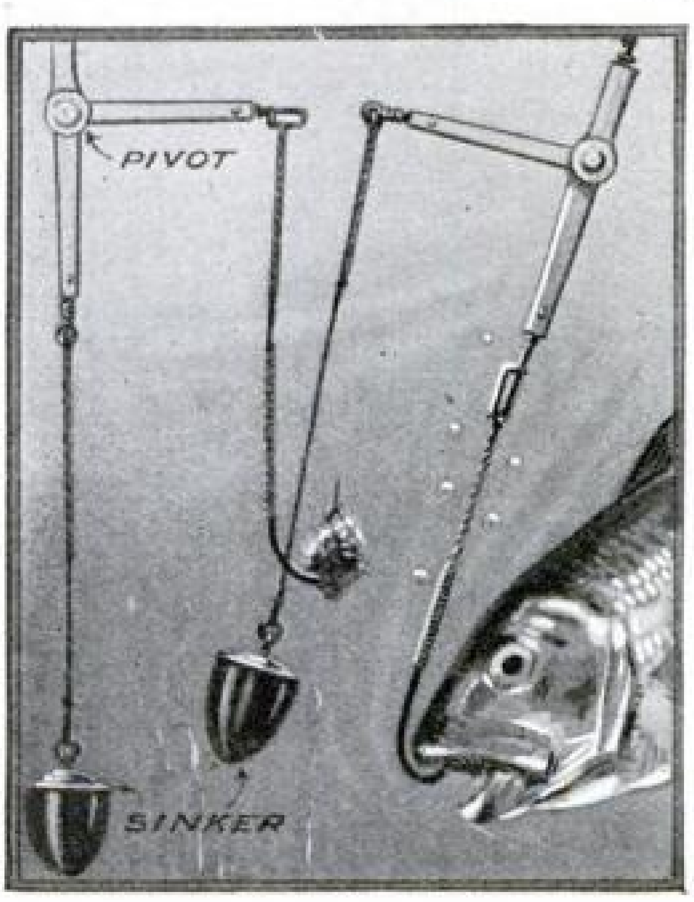
Weedless artificial bait is shown in the upper left-hand corner and above. The air-chamber and ballast cause the hollow metal fish to float horizontally. The wire spring holds the points of the double hook concealed within the body of the bait. A fish grasps the bait by the dorsal fin, depressing it, and the lug forces the points of the hook out of the slots into the fish's jaws. Many species of game fish fight shy of dorsal fins, grasping their prey more to the rear, but this bait is effective, nevertheless



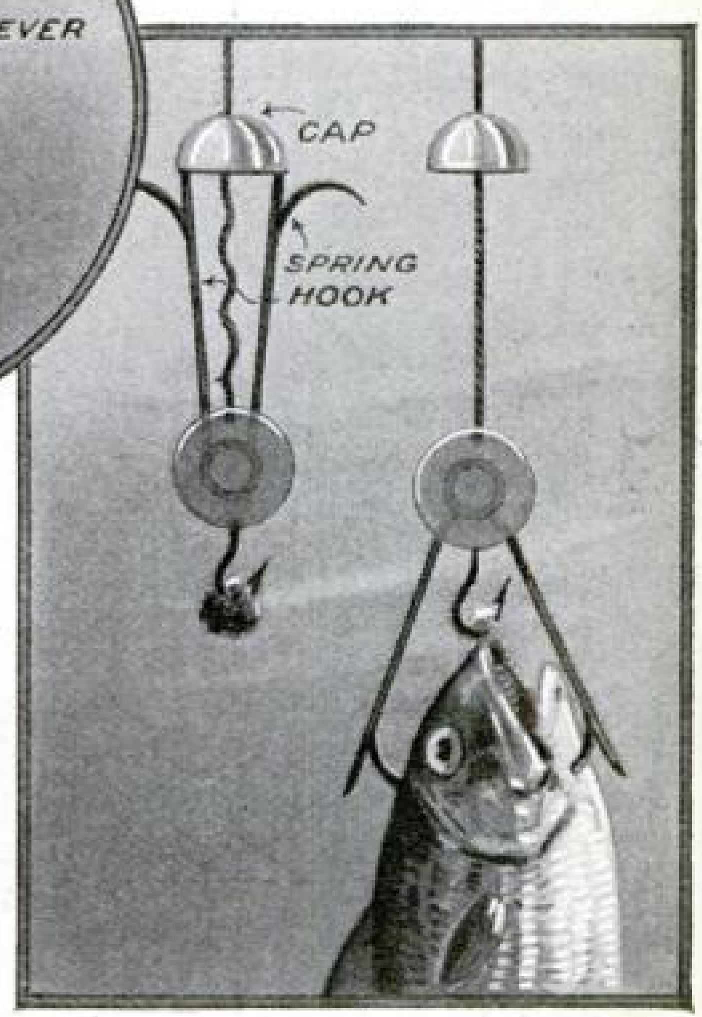
Above, automatic spring gaff trap which embeds barbed ends in the sides of the fish pulling the trigger



Above, a lever-actuated trap hook which barbs the fish pulling the bait. The trap is operated entirely by leverage, the small spring at the pivot joint serving to keep the two hooks separated



At left, non-fouling connector so constructed that the hook describes a complete circle without fouling the sinker



Above, the spring hooks are bent back and held set under a hollow wooden cap. A bite pulls the hooks down and the action of the spring forces them into the fish

A Watch-Like Coin-Case

A novel coin-holder which is made to be carried like an ordinary watch

THE market offers so many coin-cases, embodying every kind of advantage, that it seems impossible to make any improvements. For all that a new one has been invented, which has the shape of a watch so that it may be carried on a chain. It holds eight coins of the same denomination. A central disk, its periphery cut to form eight ratchet-teeth, rotates about a short shaft secured in the watch-like casing. A spring is fastened at one end to the shaft about which it is wound, and at the other end to a pin in the disk. The disk has eight radial flanges. Four flanges project from one side of the disk and four from the opposite side, alternately.

The casing has two lateral, bulging parts to accommodate two pawls which operate the disk. Each pawl consists of two fingers projecting in opposite directions from a central shaft. The one is held against the ratchet-tooth by a tiny spring, and the other acts as a stop to the adjacent tooth. The shorter one has a finger-button which projects through a slot in the case. On the under side of the outer case is a wide slot for receiving and discharging coins. The coins are alternately inserted one at a time at opposite sides of the disk, this action automatically winding the spring.

Mosquitoes on Snow Banks

IN both the Rocky Mountains and Alaska the geologists and engineers of the United States Geological Survey have as part of their regular equipment mosquito-nets for their heads. Even when working in deep snow, head nets and gauntlets are necessary to protect the field men from the blood-thirstiness of the pests. The mosquito does not vanish with increasing altitude. At eleven thousand feet, or timberline, he is as prolific as at sea-level, and smoke, no matter how dense and pungent it may be, will not eradicate him. The only sure relief lies in the net. In some sections of Colorado the mountain natives let mosquitoes bite them until their systems become thoroughly inoculated with their poison. After this they are bothered no more. The first advice given to the "tenderfoot" by the old-timer is, "Let 'em bite; they won't keep it up long."

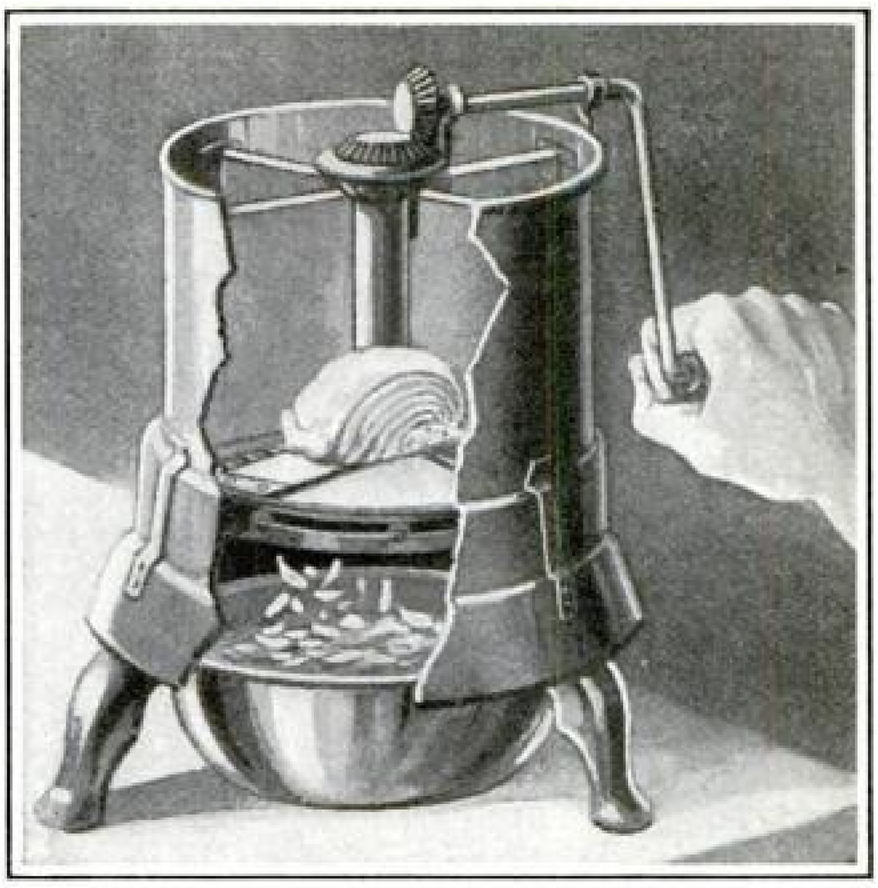
Fighting mosquitoes is a man's job and the mosquito-net is the most effective weapon

An Improved Vegetable-Slicer

A VEGETABLE-SLICER which can be adjusted to cut anything into tiny shreds, from a carrot to a cabbage, may be described as follows:

An annular base, mounted on feet, has several roller bearings journaled on the inner side of its rim. Resting on this base, and attached to it by clamps, is a cylindrical hopper. A cutting-disk is provided with three or more slots, radially cut, with a corresponding number of blades, which can be adjusted at their edges. There are also a like number of splitter-knives which assist in cutting up the vegetables. When in position in the machine the disk rests on the roller bearings and is rotated by a handle-shaft. Fitting around the vertical shaft is a tube or hub from which radiate four or more partitions, thus dividing the hopper into four or more compartments.

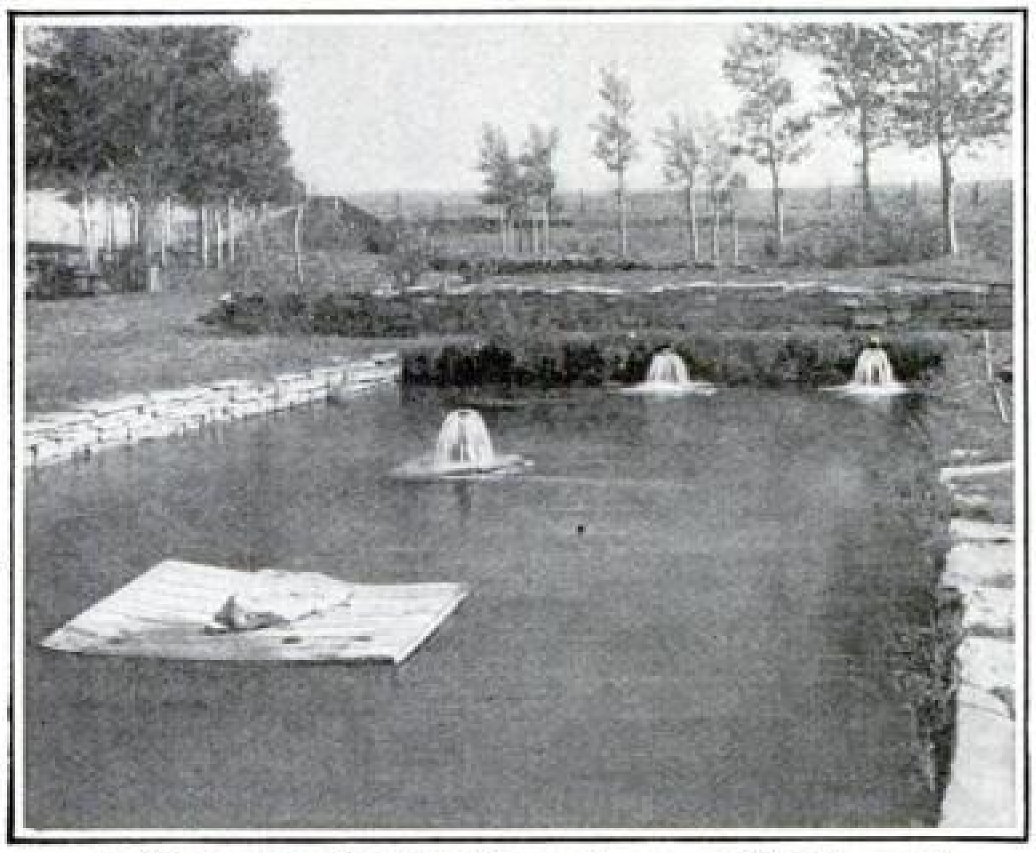
When the vegetables are placed in the hopper the action of the cutting-disk beneath them gradually slices away the whole vegetable, the particles falling through the slots into a dish. Not only the size and number of the blades can be adjusted, but the plates which form the chambers are made to fit into grooves on the central hub and inner surface of the hopper, so that they slide in and out very easily. Thus small vegetables, large vegetables or both may be sliced at one time.



Large and small vegetables can be sliced at one time with this improved device

Fish Hatched in Artesian Basin

ONE of the most unique and convenient fish hatcheries of the government is located near Laramie, Wyoming, where sources of good water are few and far between, the region being semi-desert. This hatchery is an artificial pond fed by a never-failing artesian well which flows of course night and day. The water comes from a considerable depth and is therefore pure and cool. It is claimed that better results are obtained from raising trout from this hatchery than when ordinary surface water is used. The float in the center of the pond serves as a shady nook in which the young trout can find a cool, shadowed retreat such as this game fish delights in. When the little trout have attained the proper size they are taken out and used to stock the streams in the vicinity. After the water has served its purpose as a trout breeder it flows off through pipes and is used to irrigate the little ranch farmed by the keeper of the hatchery.



A Wyoming fish hatchery is an artificial pond fed by a never-failing artesian well

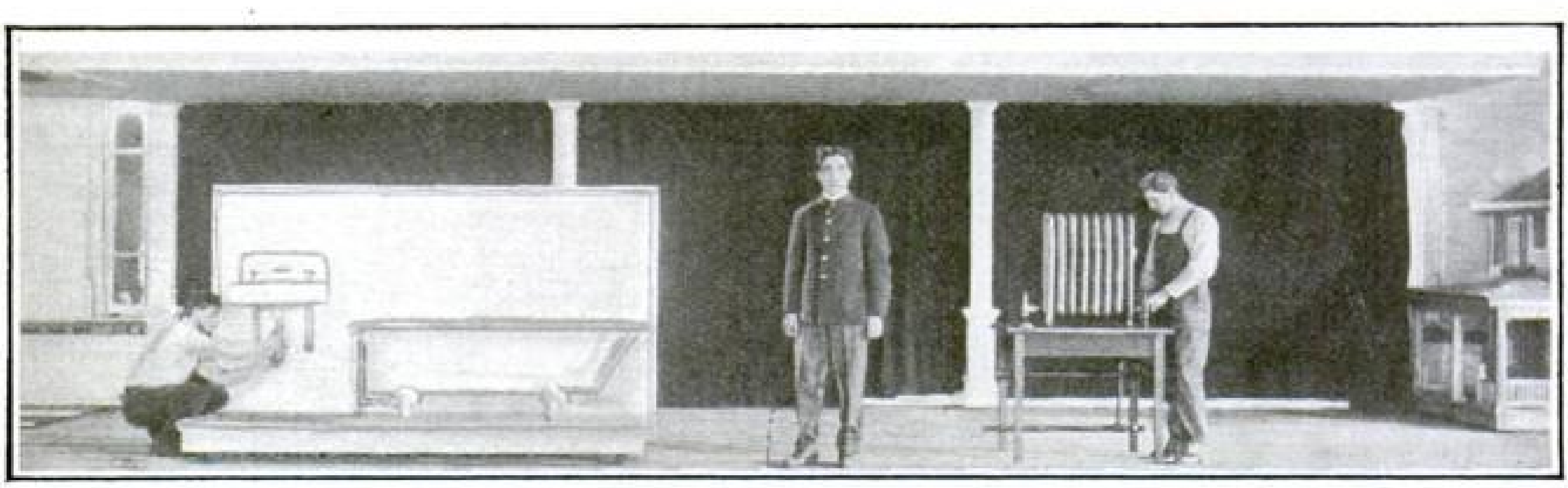
How Indians Graduate from Carlisle

A GAYLY decorated platform on which are seated the graduates, faculty, speaker and other invited guests; a lengthy program of music, orations and addresses, probably all cut to order and sugar-coated for the occasion; an award of sheepskins and a benediction—this, in brief, constitutes the stereotyped graduation ceremony of most colleges and schools.

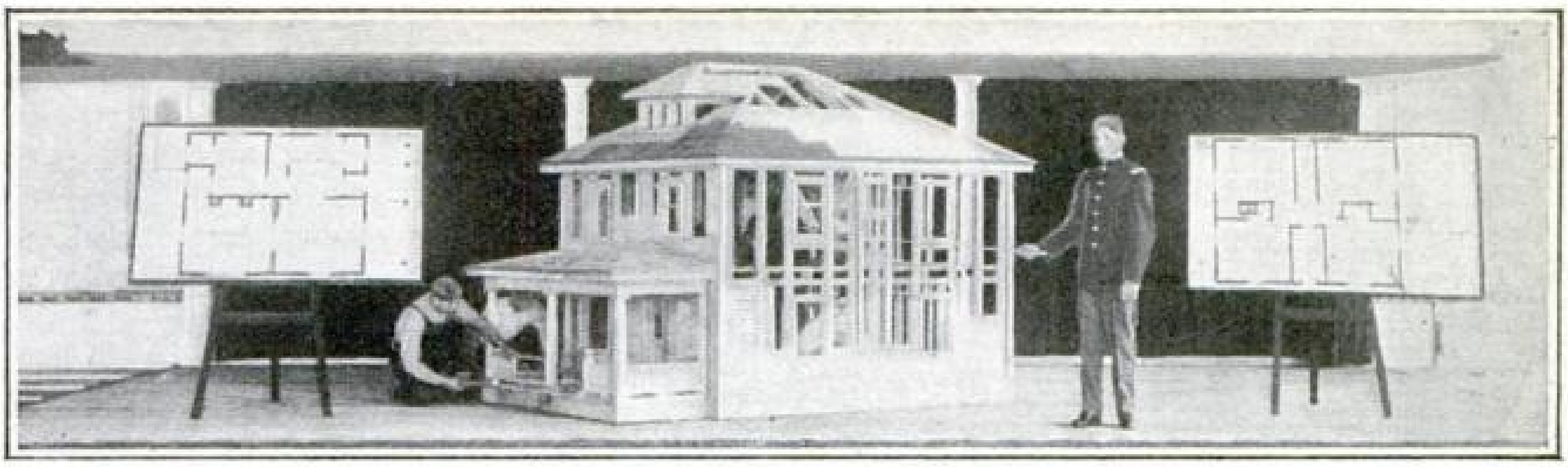
But there is one school which has a different commencement. It is the United States Indian Industrial School at Carlisle, Pennsylvania. Its twelve hundred students are children of America's original people, and the institution is the largest industrial school in the country. Until recently commencement activities followed closely the lines of the average college exercises, with orations and addresses scheduled by instructors in close keeping with the academic part of the school's work.

Today commencement at the Carlisle school is unlike any other. Graduation day is a day of proof as well as showing, for the Indian girl or boy not only tells what she or he has done, but actually shows how each has succeeded. This event is held in the school's immense gymnasium and audiences of ten thousand people and more from all parts of the United States attend. At the door you are met by a polite Indian usher, spick and span in a school uniform of blue and gold. He finds you a comfortable seat and a program. You look about but see no person in charge of the activities. Over in one end of the gymnasium you hear whispers. Sitting there are several hundred little Indian girls and boys of the short dress and knee-breeches age. The school band of fifty pieces is on a low platform at one end of the room. When the hall is full, a low whistle is heard at the entrance, and then the band breaks into a martial air and into the room troop the upper classes, each headed by its banner carrier. The rear is brought up by the graduates. Presently all have found their places. The platform is yet unoccupied, and there is apparently no leader for the afternoon's event. From

Indian girls are given a thorough course in sewing. At graduation they prove that their knowledge can be applied in a practical manner



A demonstration in plumbing is conducted as part of the graduation exercises. One student explains the proceedings while others do the actual work



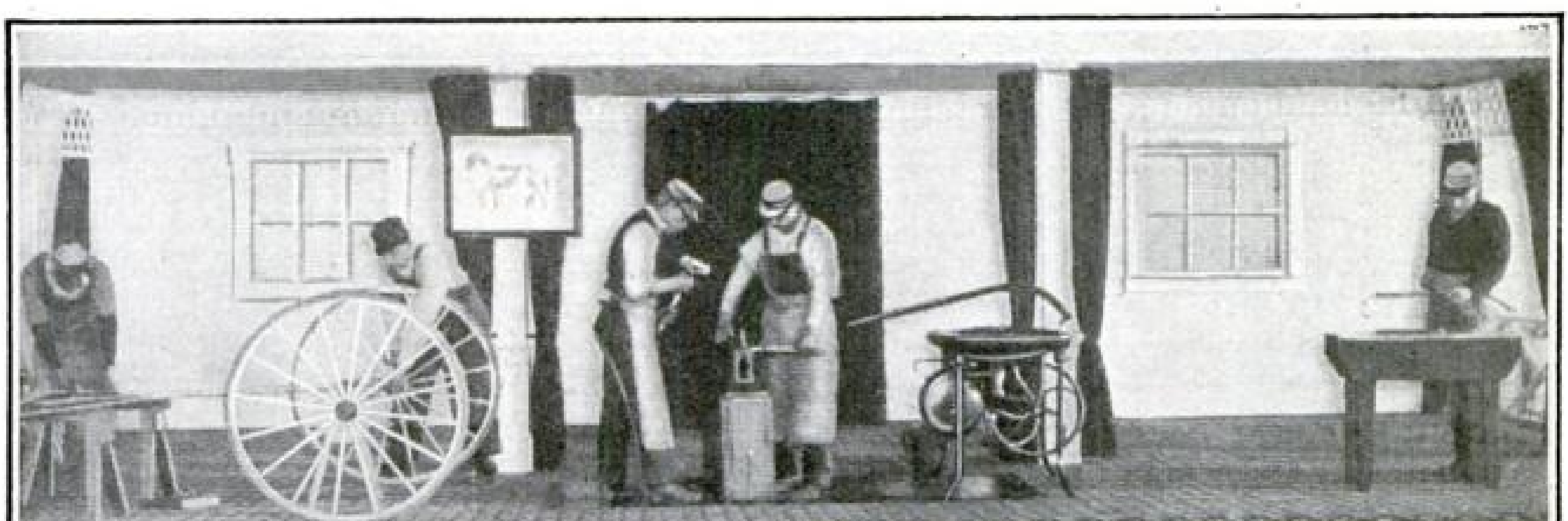
The audience is given a concise outline of the work of building a house, a neat model and working-drawings being used for explanation

Housekeeping in all its branches, from the hanging of window-curtains to the upholstering of furniture, is taught at Carlisle

the front row of the audience a clergyman arises, signals the multitude to its feet and a prayer is offered. The band then renders a lively selection, the school superintendent extends a cordial welcome to all, and graduation is on at the Indian's greatest school.

The platform is overhung with a canopy from the carpenter shop, made from lumber and resembling the roof of a porch of a residence. A girl steps to the platform, and curtains near the back of the stage are suddenly drawn. If she is a graduate in nursing, other nurses step out with two patients and illustrate her talk. If she speaks on housekeeping, such a scene as is pictured is presented to the audience. If she tells how washing in the home should be done, other girls are there to help her illustrate it. If it is dressmaking or millinery, the Indian maiden gives you the theoretical knowledge while assistants supply the practical.

An Indian lad graduates in agriculture. He has his charts of farm lands with plots to illustrate the methods of



Indian lads are taught blacksmithing. Instead of listening to commencement oratory the spectators at the graduation exercises watch the Indians make horseshoes and weld iron tires

scientific farming. Another boy is a plumber, and while he is telling of his trade helpers are putting together bathroom fixtures and sections of heating plants.

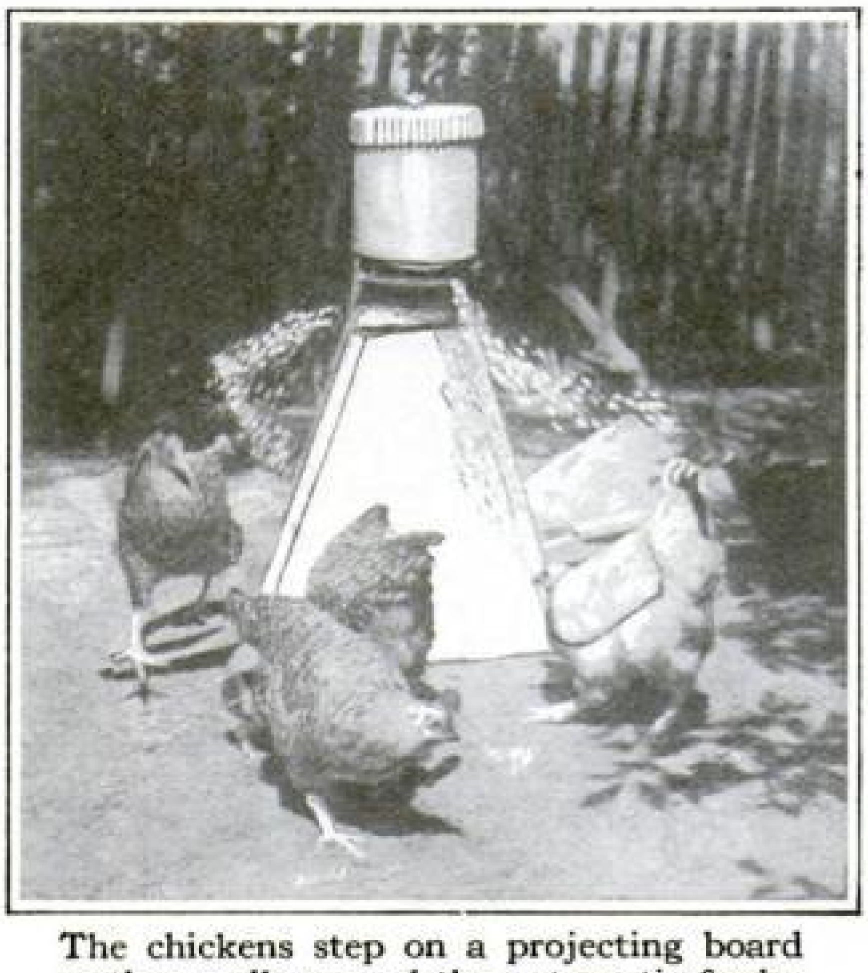
Dairying from beginning to end is described by another boy while pretty Indian milkmaids churn real butter and place it in molds for marketing. How to furnish a home is explained by another lad, while girls help him arrange various pieces of furniture in sectional rooms. Here is a splendid house model and here is a boy telling how it is erected. Helping him are other carpenters and the house shown is completed on the stage so far as the woodwork is concerned, even to placing lath for plastering and erecting the inner staircases.

Blacksmithing is another trade taught at the Carlisle school, and the trade has graduates. Accordingly, a blacksmith shop is placed on the platform. Several pieces of curved iron and wood are bolted together and wheels fastened to the ends. Running-gears of a carriage are thus made. Another lad grasps the bellows-lever of a forge and soon flames spurt upward. A smithy thrusts real irons into the fire and presently two boys are pounding out red-hot horseshoes on a real anvil. Sparks fly into the air and the ring of the anvil sounds throughout the building. Another lad finishes the shoes at a bench vise.

Government officials are always in attendance at these Carlisle commencements. With school officials they occupy seats until the Indian girl and boy have had their say. Then come the addresses of visitors, presentation of diplomas and the remainder of the program. Such is the way Indians graduate, displaying the academic and vocational education afforded by their training in such manner as to mark the Indian graduation as the most unique and interesting of all commencements the country over.

Chickens Feed Themselves On The Run

AN ingenious citizen of Illinois has invented a contrivance by means of which his chickens feed themselves, thus saving him the trouble of early rising and feeding them himself. As the man remains in bed his chickens walk around the contrivance in the barnyard and inadvertently step on the ends of a projecting board. The weight of each chicken is sufficient to tilt the board, so that the grain placed in the receptacle at the top of the apparatus the evening before is thrown to the ground. As fast as the grain falls it is picked up by the chickens and the more chickens there are operating the automatic feeder the faster the grain falls to the ground.

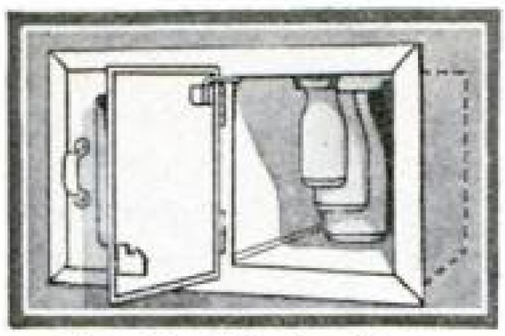


The chickens step on a projecting board as they walk around the automatic feeder and this causes the grain to fall from the top

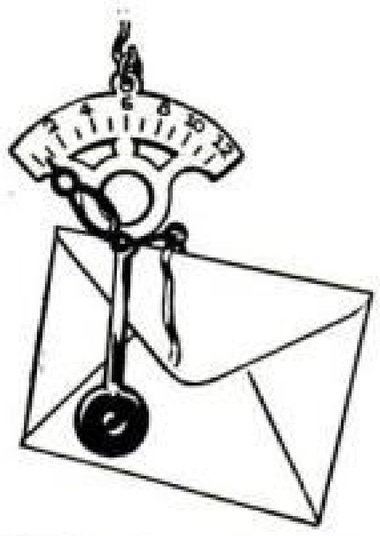
When the first chicken walked on the projecting board and discovered that the faster it walked the faster the grain fell in front of it, other chickens fell in line and it wasn't long before the whole barnyard flock was marathoning around the contrivance, eating up the grain as it fell and working up appetites for the next meal at the same time.

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. The editor of The POPULAR SCIENCE MONTHLY is willing to answer questions.

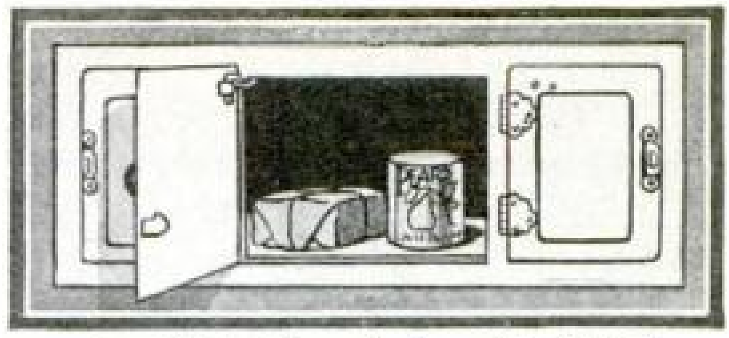
Housekeeping Made Easy



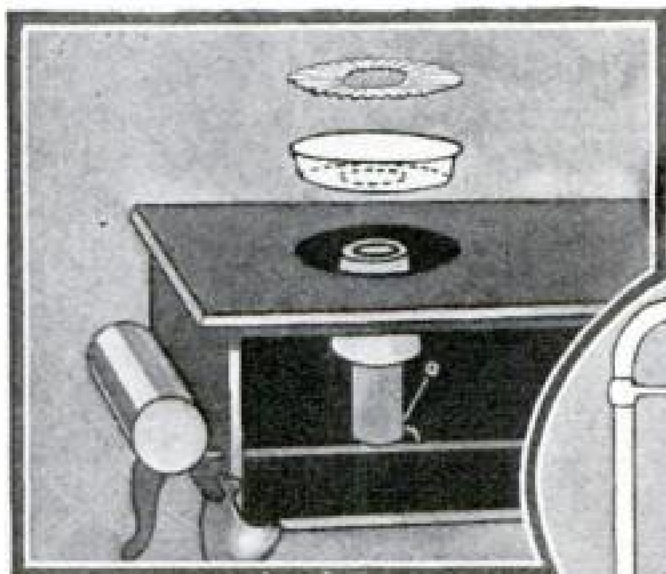
A wall-cabinet refrigerator which holds bottles of three sizes



Handy letter-scale which weighs up to twelve ounces

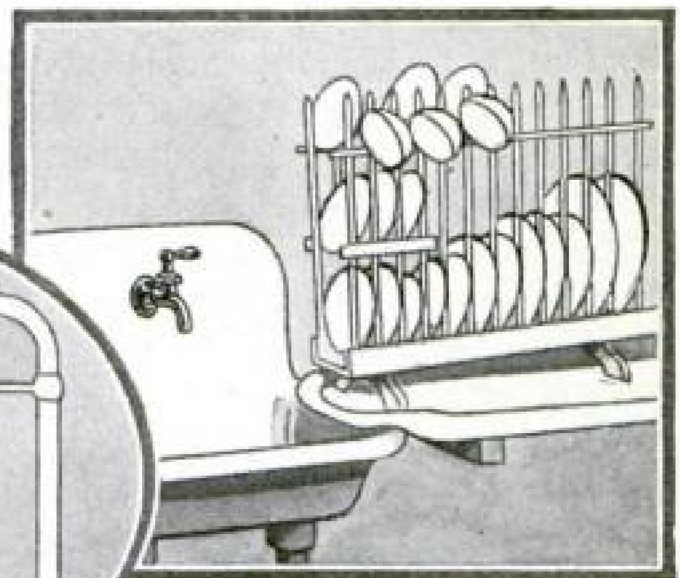


A self-locking steel wall-cabinet with three compartments for perishable goods

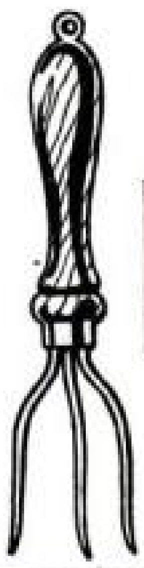


Pie-pan with a hole in the bottom increases heating capacity of the gas-stove burner

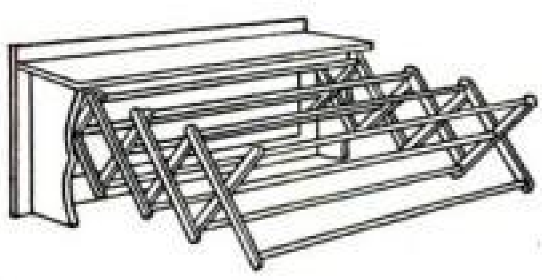
Convenient bedside tray or table attached to the bedpost



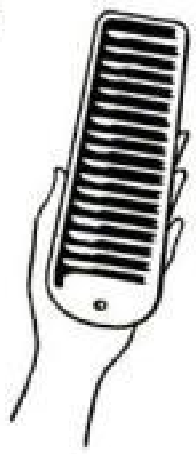
Dish-drying rack of wood which takes the place of the unsanitary dishpan

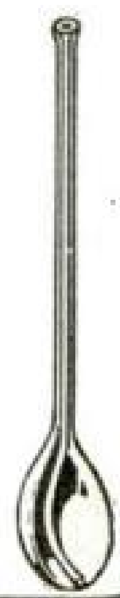


At right, fork for lifting potatoes without breaking them. At left spoon with knife edge

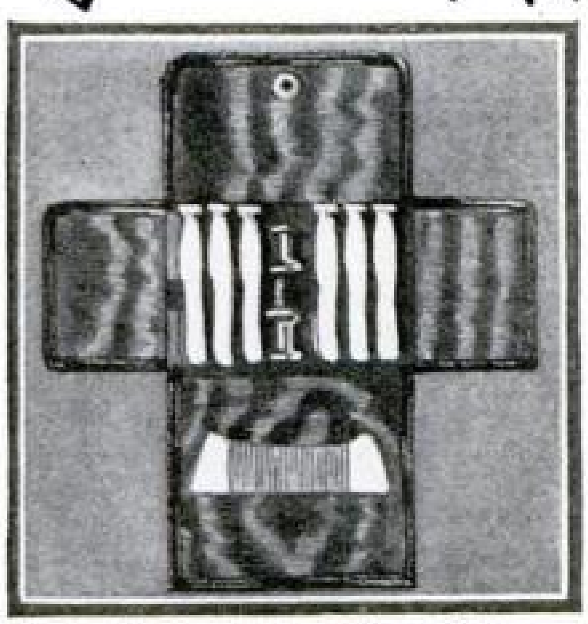


Combination shelf and clothes-drier for the laundry

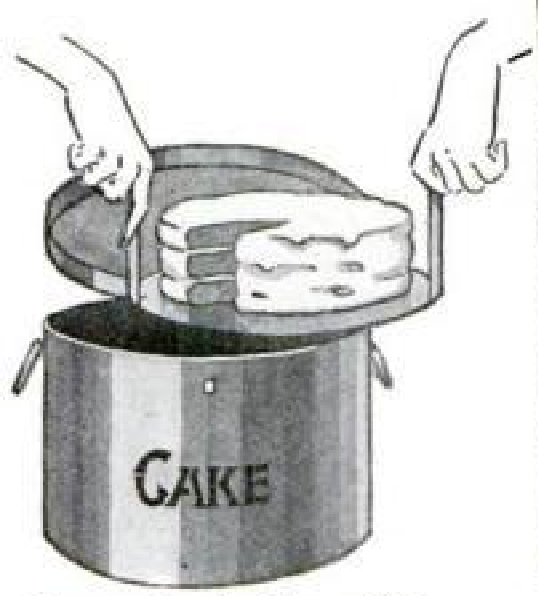




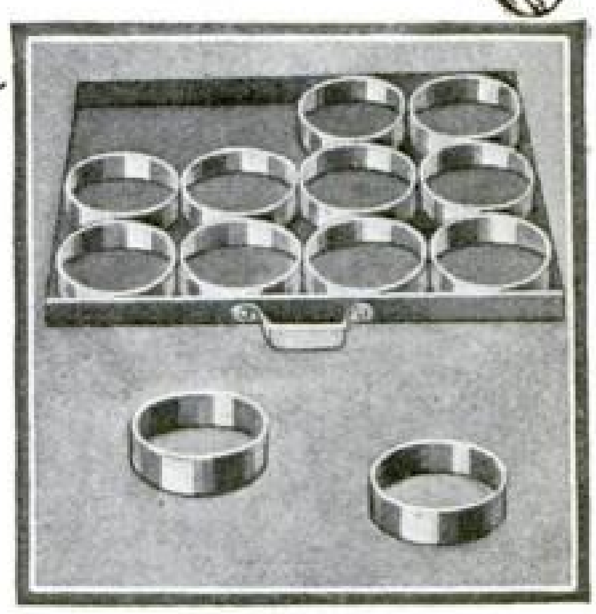
At right, silver spoon with liquid tube-handle for invalids. At left, diminutive wash-board for cleaning handkerchiefs



Bedroom laundry set with line, two glass-headed nails and six clothes-pins



A round cake-box with handled plate which makes lifting easy



A muffin-pan with six or twelve removable rings to facilitate cleaning

How to Run a Motor-Boat

WHEN starting the motor, close any auxiliary air valves and hold the hand over the air inlet of the carburetor so as to draw in a richer mixture, otherwise the mixture may be too weak to start the motor. If the mixture seems to be rich enough, the engine may start off if a little lubricating oil is let into the cylinder which will make the compression better. Irregular firing usually comes from carburetor and spark troubles. Drain the carburetor and if this does not seem to remedy the trouble investigate the electrical apparatus. Clean the spark-plug and see that the gap is right; the thickness of the thumb nail is a good gage. Too large a spark is apt to be wiry and quickly exhausts the battery. The vibrators of the coils should not be set too loosely in the hopes of saving current, but should be set to produce a sharp, clear spark. They do not need to be too tight.

When a two-cycle motor fourcycles, that is, fires on every other revolution, the gas is too rich and should be cut down at the needle-valve until an even cycle takes hold. Weak explosions and backfires through the carburetor indicate that the mixture is too weak and should be increased. If an engine runs steadily but seems weak the trouble may be in loss of compression, poor lubrication, poor design, or parts out of alinement, carbon or clogged outlets and gas passages. Sudden stopping is usually due to a broken electrical connection; while slowing up and stopping is caused by lack of gasoline or clogged feed line; engine too hot or poor lubrication. Overheating of the engine is usually caused by a lack of lubrication or poor circulation of cooling water. The pump should be examined and if working badly should be repacked and oiled.

Boating is about the only sport or business in which there is so much courtesy. A helping hand is always given if need be and you always seem to be expected to salute any passing boat.

When steering in a fog without a compass it is nearly impossible to maintain a straight course. Take a long line with a float tied to one end and let it drag over the stern. The line will drag directly behind when you are steering a straight course and will swing sideways when the boat swings away.

Prize Winners of Sam Loyd's Puzzles

For April

The honor prize of $5 is awarded to:

John J. Furia, Hamilton Hall, Columbia University, New York City.

The ten $1 prizes are awarded to the following solvers:

Edward Hillery, Sherrard, Ill.
W. H. Fitzgerald, 87 6th Street, Pelham, N. Y.
A. M. Stimpson, 163 Hemenway Street, Boston, Mass.
William S. La Londe, Jr., 1354 Asbury Avenue, Evanston, Ill.
R. T. Huntley, 1136 Center Street, Newton Centre, Mass.
A. Prescott Barker, 13 Arlington Street, Lynn, Mass.
Fred A. Tracey, 37 White Street, Mt. Holly, N. J.
L. M. Merrill, Glendale, Ohio.
Edward Norton, 26 Grove Street, Rockland, Me.
Francis E. Stanley, Newton, Mass.

For May

The honor prize of $5 is awarded to:

L. F. Woodruff, 22 Cherry Street, Atlanta, Ga.

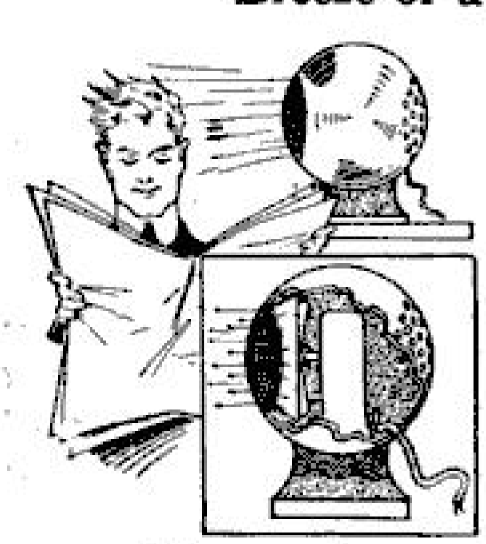
The ten $1 prizes are awarded to the following solvers:

Fred. Ausehurtz, Oak Lawn, Ill.
Harry Pence, 2723 Euclid Avenue, Cincinnati, Ohio.
S. V. Halsey, Lee, Mass.
Homer Calkins, Dallas, Oregon.
E. Elwert, Route 2, Conshohocken, Pa.
Frederick G. Dilger, Overlook Hospital, Summit, N. J.
Charles W. Zaring, Hay Island, Gananoque, Ontario, Canada.
August Kuehn, 726 Proctor Street, Port Arthur, Texas.
Wallace C. Harding, Randolph, Mass.
O. E. Cote, 184 Harrison Street, Pawtucket, R. I.

Little Inventions to Make Life Easy

Why Weren't They Thought of Before?

A New Way of Directing the Breeze of a Fan

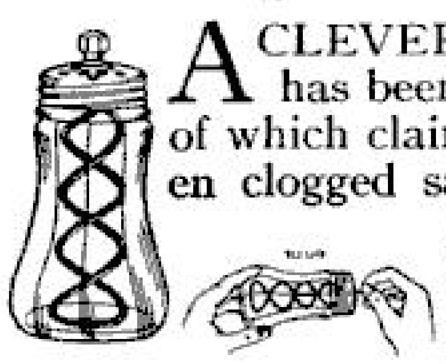


A FAN motor is enclosed in a spherical shell, so that no moving parts are visible. The current of air generated by the fan is directed through a nozzle which is covered by a wire mesh as a protective measure. The air is forced out in a parallel current, and blown in any desired direction.

Handling the Cord of Electric Irons

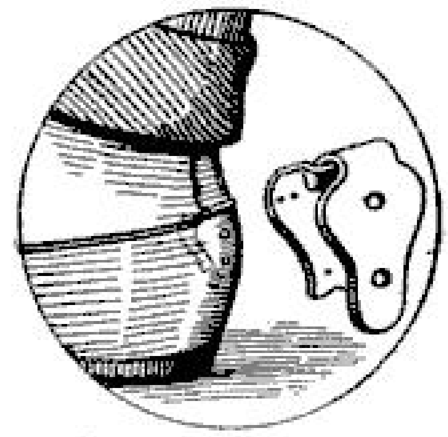
THE convenience and usefulness of electric flatirons is sometimes impaired because of the connecting cord's continually catching on the end of the ironing-board or other obstruction. An arm-band has lately been invented which will hold the cord close to the operator's elbow, and thus make it follow all motions of the arm naturally. This not only conserves the temper of the user but saves wear on the cord.

A Salt-Shaker Which Will Not Clog



A CLEVERLY devised shaker has been made, the makers of which claim that it will loosen clogged salt. It is of clear glass with a non-corrosive white metal top. A spiral loop of wire which occupies the center of the shaker, is turned by a twist of the knob above the lid. The coil of wire when turned reaches every part of the interior of the shaker, thus breaking up the salt.

At Last! A Lock For Slipping Rubbers

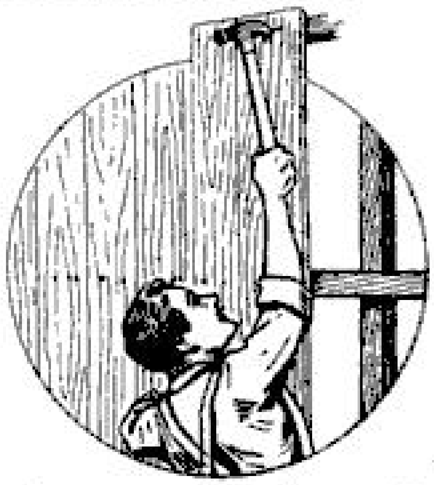


RUBBERS and overshoes are apt to slip from the foot and stick in the mud when a little worn—as every commuter who has hurried to catch a car knows. A new device has been brought out, which consists of a hook-like member riveted to the rubber and a socket attached to the shoe, both being made of metal. The hook catches in the socket and holds the rubber shoe securely until it is removed by hand.

Adjustable Kettle-Cover

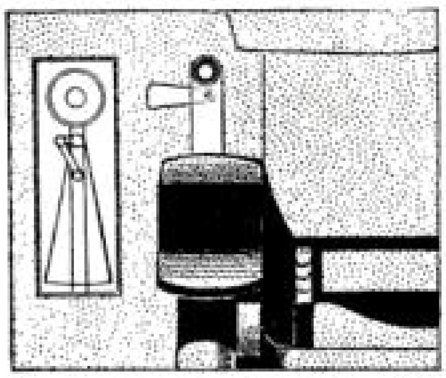
AN adjustable kettle-cover of a conical shape with a handle at the side is so made that by a slight pressure on the handle and a simple adjustment, the cover fits any ordinary pot or pan. The conical shape allows steam to gather in the top; this not only prevents boiling over but also serves to cook the food more thoroughly. The volume of steam held within the dish hastens the cooking process.

Hammer for One-Armed Man



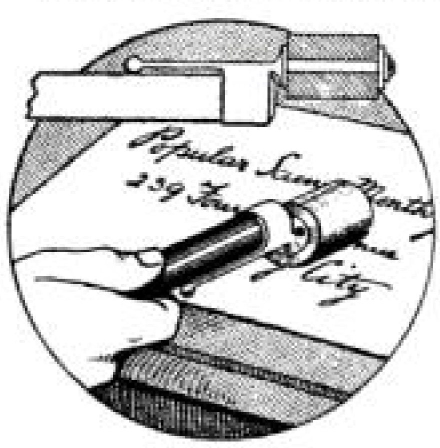
THE illustration shows a hammer which is very useful to the one-armed man. With it he can set nails as well as if he had both arms. The hammer is also very useful to the normal person. It adds some two feet to any carpenter's reach.

Semaphore Signals for Automobiles



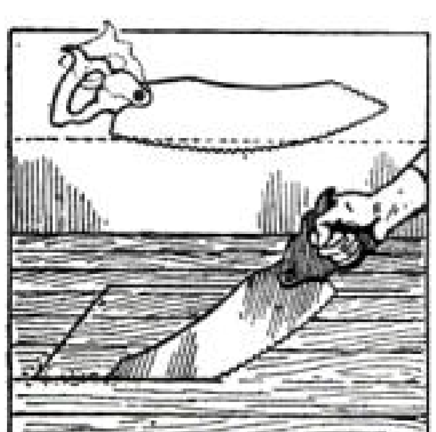
THE illustration shows how an automobile driver may convey his intentions to the occupants of a car in the rear, by means of a semaphore signaling device. It will be noticed that the two semaphores are mounted on the rear mudguards of the car; and by means of an electromagnet concealed in each column the signals can be controlled from the driver's seat. If the automobile is to stop, both semaphores will be thrown up; if a turn to the right is intended, the right semaphore arm will be displayed. For night use electric lights are provided in the signal columns, and by means of red and green glass disks in the semaphores the desired signals may be easily displayed.

Combined Penholder and Blotter



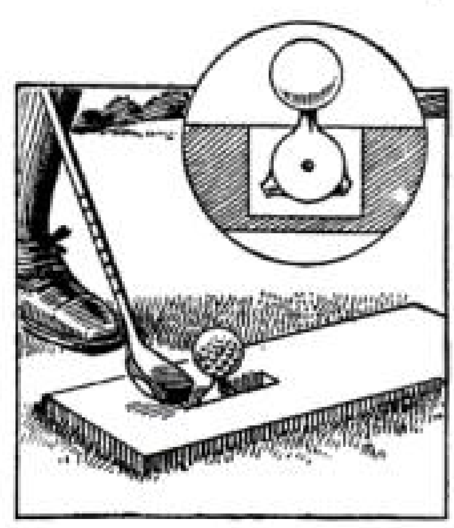
A NUMBER of disks made of blotting paper are held on two small washers which are fastened to the ends of a central axis. This device is attached to a penholder by means of a clip similar to those commonly used to hold a pen or pencil in the pocket. In use, the blotter is rolled over the writing, instead of being placed flat.

Saw Cuts Square Hole



A SAW that cuts a square hole in a floor without the aid of any other tool is shown in the illustration. The saw is rounded so as to make the incision and provided with an adjustable handle so that the strain on the wrist in the initial stages is eliminated. An auger bit is not needed.

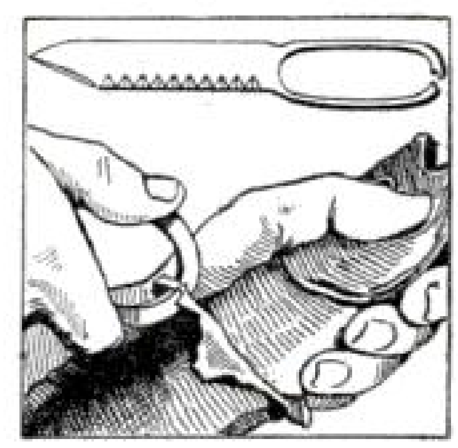
An Adjustable Golf-Tee Board



A GOLF-TEE board which provides three tees at different elevations above the board has been invented to meet the ideas of individual players. On a disk revolving in a vertical slot or opening of the board the three tees are attached and project varying distances from the axis of rotation so that the balls may be supported at different elevations above the board.

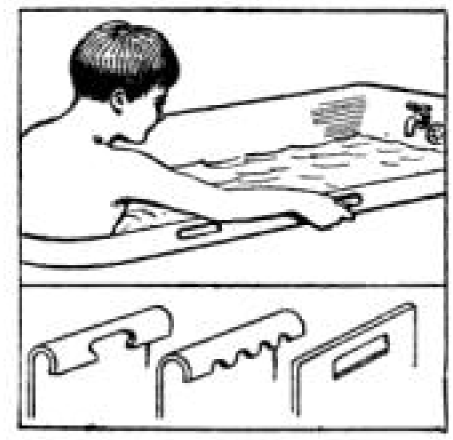
When the ball is driven from either one of the individual tees the tee as a whole will yield and turn in the direction of the blow, thus reducing the possibility of injury to the tee and permitting an unretarded release of the ball.

Skinning the Slippery Eel



THIS clamp-like tool grasps the skin of an eel, tweezer-fashion, and strips it off in much the same way as one removes a glove. Special notches enable the jaws to grip the skin securely. The opposite end of the tool is a knife-blade useful in further dissection. Projections on the back of the blade are handy in scaling fish.

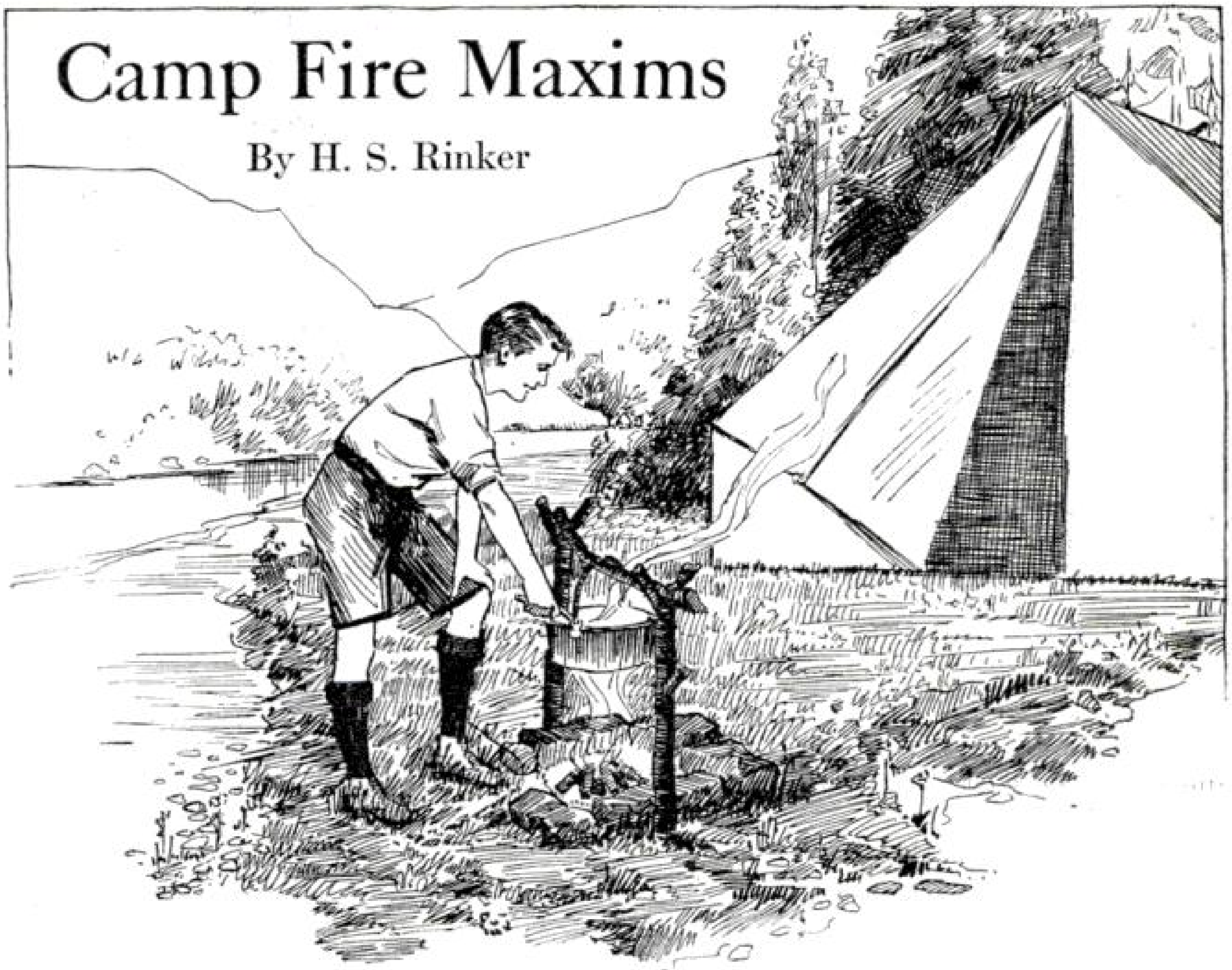
Why Fall Down in Your Bath-Tub?



PERFORATIONS are made in the bath-tub rim to serve as handholds, the holes being cut in a variety of forms as shown. A firm grip can be secured on these even though the hands be slippery with soap. Thus the slips and slides frequently resulting from an insecure handhold are avoided.

Camp Fire Maxims

By H. S. Rinker



To build a fire, whittle a stick, leaving the shavings projecting on its sides. Push into the ground and build up small sticks around it; then ignite

CLEAR a place for the fire, so that it cannot spread. One of the best ways is to dig a ring around it, so that damp earth interrupts the dry grass or dead leaves which may be present.

See that the flame will not scorch trees. Never throw away a match—not even a burnt one or a wet one. When you have used a match, pinch out the glow with your fingers, and *stick it into the ground*, burnt end down. Millions of dollars have gone up in smoke for lack of this simple precaution.

If a match is wet, rub the match head through your hair for a few seconds, and it will almost invariably light when struck. Keep matches in a metal box, with a water-proof lid.

Remember that birch-bark or dry pine-needles are fine kindling.

Remember that a small lens will start a big fire if the sun is shining.

To start a fire in dry weather, whittle a dry stick so that the shavings stand out at an angle, but do not cut them off. Stick this kindling in the ground. Build up, tepee fashion, other small dry sticks around it. Put some dry pine-needles, birch-bark, or paper at the base of the stick, and touch it off. It starts quickly.

To Start a Fire in Wet Weather

Locate a sheltered spot. If that is not possible, find an old log, a flat stone or a decayed stump. Roll the log half over. This exposes the dry side. Build your fire against this or against a flat stone, propping up one edge and building the fire under it. Or gouge out a rotten stump and build the fire in the cavity.

The powder from a cartridge cut open and emptied will help, especially if slightly dampened.

Always stamp out, drown out, or bury your fire before leaving camp. *Never forget to do this.*

A match is not necessary for starting a fire if a lens is at hand to focus the sun's rays on the fuel and ignite it

To Carry Fire on a Boat

Put it into a bucket with sand or earth in the bottom. Always try to use live coals or embers for this purpose. They will hold for a long time if covered skilfully with damp moss.

To Build a Fireplace for a Semi-Permanent Camp

Set a flat stone on edge for the back. The sides are two flat stones about 6 ins. thick. The front is open. Dig a small pit about 6 ins. deep between the stones. This will soon fill with ashes. Don't remove them. They are fine for roasting corn, potatoes, fish, etc. The stones make a curb which adds much to the draft of the fire. The side stones get hot. These serve to put the coffee pot on after it is boiled. Boil it seven minutes. Then set it on the hot stone till wanted. If you want to roast corn, strip it down, remove the silk, pull back the husks and put it under the edge of one of the stones. Pull the hot ashes over it. Treat potatoes the same way.

Fire is prevented from spreading by a simple trench dug around it

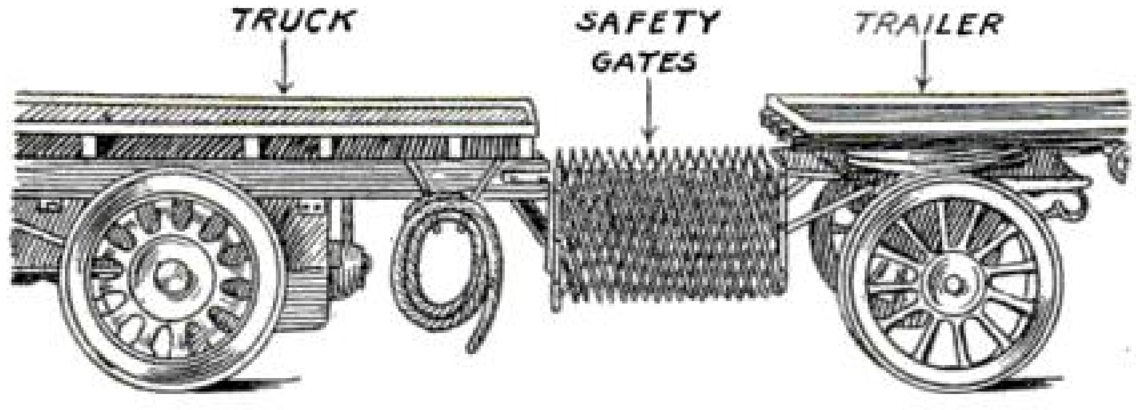
To Bake Fish

Clean them, season, wrap them with corn-husks, wild-grape leaves, or sassafras leaves, cover with moist clay and bury in the ashes.

Venison and all kinds of meat other than bacon or cured ham can be kept from flies by hanging eight to ten feet above the ground in flour sacks. Never wrap cloth around fresh meat; it serves to hasten decay. Venison should not be washed unless it comes in contact with dirt; washing destroys its delicate flavor.

Using Gates to Lessen Danger from Truck-Trailers

THE rapidly increasing use of motor-trucks as tractors for hauling trailers of various kinds has resulted in the development of protective devices to prevent the injury of thoughtless pedestrians who unwittingly run in between a truck and trailer, when endeavoring to cross a street, thinking that they are separately propelled vehicles running close together. An English safety-gate arrangement is here illustrated. The gates are built on the lazy-tongs principle so that they can close up or extend as the trailer rounds a curve. They are securely attached to triangular supporting frames, fastened to the rear end of the truck frame and the front of the trailer, as indicated.



Many accidents might have been avoided by the use of this arrangement

They are constructed in various sizes to span the smallest and the largest distance between a truck and a trailer. In some instances they have taken the place of the customary danger flag which is often unnoticed.—VICTOR PAGÉ.

For Practical Workers

How to Make an Efficient Boiler-Patch

THE usual method of patching a boiler cannot be relied upon for high efficiency. Suppose there is need of a patch at the check-valve hole of a locomotive-boiler. The radial cracks, most often along the length of the plate, start out from the hole. If a disk of boiler-plate is applied with a single row of rivets, as shown in Fig. 1, there is danger of tearing the boiler-plate or the patch, between the rivets; also of shearing the rivets.

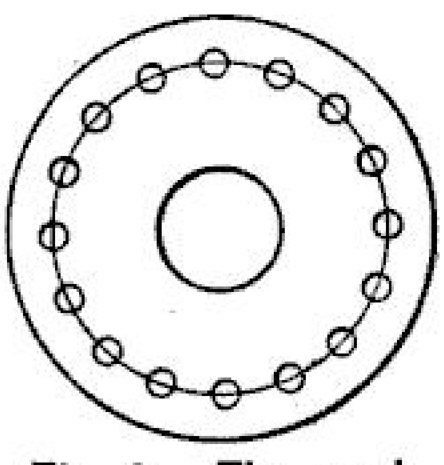


Fig. 1. The usual form of boiler-patch

The more rivets are used, the weaker the patch, since every hole weakens the plate. This may be seen by examining Fig. 2. The first piece of cardboard is solid all the way across; the second has a hole in it, making the resistance to tearing just that much less. The only way to prevent shearing the rivets is to add more rivets opposite the defect, but this increases the number of holes and actually weakens the plate.

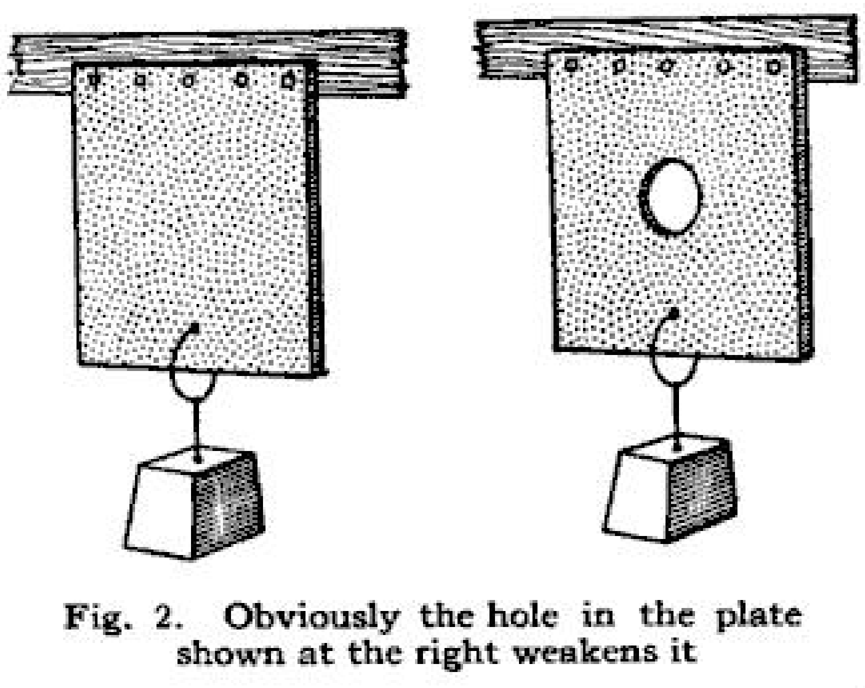


Fig. 2. Obviously the hole in the plate shown at the right weakens it

This difficulty can be avoided by the use of a patch like the one shown in Fig. 3. Two rows of rivets are used. The additional number of holes does not weaken the patch, however, because the force tending to pull the plate apart does not act at right angles to the line of rivets. The component of this force is to be reckoned with and the greater the angle of the rivets the less this force will be. By multiplying the number of rivets it is possible to mass more metal opposite the defect than there would be in the original plate, and the efficiency in shearing will be even greater than one hundred per cent. The observance of this simple expedient, which simply takes into consideration a principle of physics, will result in far less danger from weak spots in a boiler.

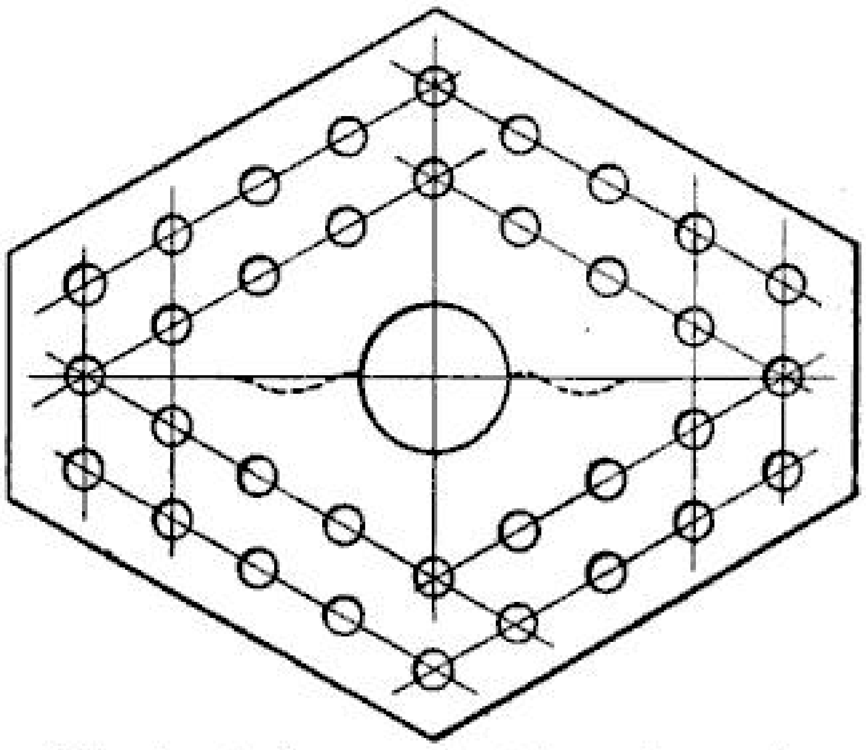


Fig. 3. An improved patch can be made by placing the rivets so as to prevent the strain from acting at right angles to them

An Easily Made Mercurial Barometer

THE accompanying diagram, Fig. 1, shows a useful barometer of simple construction. The baseboard A may be of mahogany, 38 ins. long, 2½ ins. wide in the central part and 4 ins. at the ends. A straight glass tube B is needed, 36 ins. long and about ¼ in. in bore. After filling by the simple method about to be described, it may be fastened to the center of the board by means of neat brass saddles. The cistern C, to be described in connection with the method of filling, is provided with a wider saddle at the lower end of the board. This may be hidden, for the sake of appearance, by means of the polished mahogany disk M. The appearance will be improved by turning the disk, or providing a small beveled mirror in the center. The upper end of the tube may also be concealed by means of an ornamental disk of turned wood.

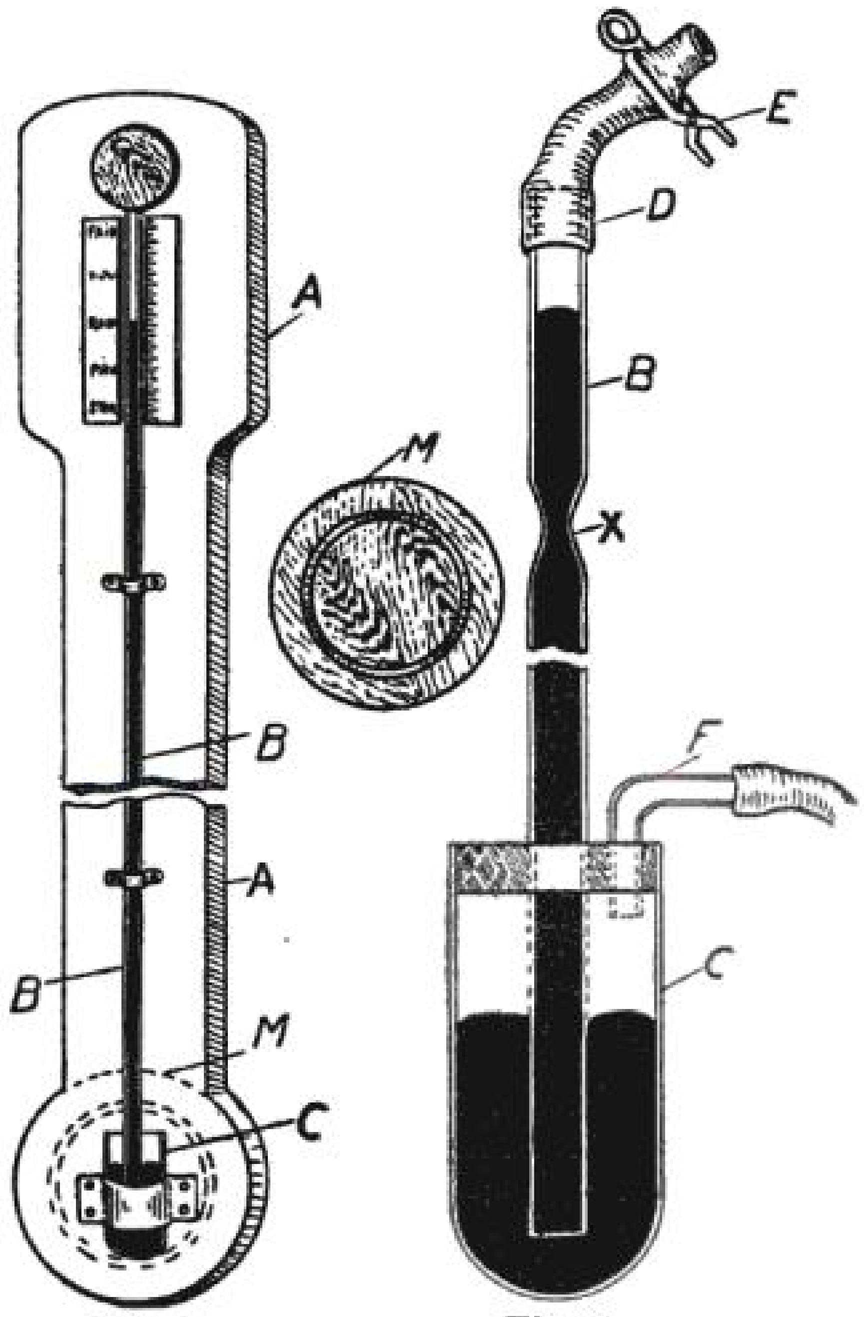


Fig. 1 Fig. 2

A mahogany base, a glass tube and a mercury cistern comprise this barometer

It is in filling the tube with mercury that most amateur barometer makers experience the principal difficulty, owing to the necessity for excluding air. The regulation method is fairly easy in experienced hands, but the following will be found much simpler. The tube B, Fig. 2, is of soft glass with walls of medium thickness. It is therefore a simple matter to make a constriction at X, 3 ins. from one end, by softening the tube in the flame of an alcohol lamp and drawing the ends gently apart. To the open end above the constriction should be attached a short length of India rubber tube D, capable of being closed with a brass clip or pinchcock E. The other end of the tube should be passed through an India rubber cork, fitting tightly into a wide glass tube C, forming the cistern. A bent tube F, previously passed through the cork towards the side, serves for connection with a cycle-pump and valve, with thick-walled rubber tube.

Let the tube be supported vertically, the cistern being rather more than half filled with mercury—before inserting the cork, of course—and force a little air in with the pump so as to drive mercury into the tube to about two-thirds of its length. Without removing the cycle-valve attached to F, that is, without letting any air escape, lower the tube gradually in a slanting direction. The mercury will rise still higher until it passes the constriction and fills the India rubber tube. Then close the pinchcock, remove the valve from F, and replace in the vertical position. The mercury will come to rest somewhere near the end of the tube, as shown in Fig. 2. The space above it is a vacuum since the air has been driven out and prevented from re-entering. The upper end of the tube above the constriction is no longer required and may be removed by directing the alcohol lamp flame against the narrowest portion with a mouth blowpipe, (or even an odd piece of thin tube), the same operation serving to close the top of the barometer tube with a neat and perfectly airtight seal.

A scale of inches and tenths must be made on glazed cardboard or imitation ivory and attached to the top of the board, a similar scale being fixed on the other side of the tube to show the words

"rain," "fair," etc., if required. It is presumed that reference can be made to a standard barometer for the purpose of determining the points of the scale. Two comparisons should be made on different occasions, once when the standard instrument is very low, and once when it gives a high reading. Say the two readings are 27 and 31 ins. respectively. Then the distance between the two corresponding positions on the home-made barometer may be provisionally divided into 40 equal portions and called tenths of an inch, the figures being marked to correspond. But an effort should be made to check as many of these intermediate positions as possible by comparison with the standard instrument.—H. J. Gray.

Killing Vermin with Gas

HYDROCYANIC-ACID gas is one of the most efficacious agents in ridding households of such pests as bedbugs, fleas, cockroaches, ants, clothes-moths, etc. Rats and mice, when exposed to its fumes, run out of their holes into the open and die there. There is thus no subsequent annoyance from dead rodents in the walls and under flooring.

Even when only one room of a house is to be fumigated the entire house must be vacated and so closed and marked with signs that everyone is kept out. The windows in such a house must be equipped with ropes so that they can be opened from the outside when the fumigation is done. If the house is close to another, especially if its windows are below those in an adjoining house, care must be taken to protect neighbors. This is especially necessary in the case of a house in a row, particularly if the partitions separating houses are not tight, or if its attic or roof air-space communicates with those in the neighboring houses. For these reasons, in the case of summer cottages at beaches, it is safest and easiest to fumigate before the family or neighbors have moved in, when there is plenty of time to air the house completely after it has been treated.

While hydrocyanic-acid gas is probably the most efficient means of ridding a house of vermin, it is also one of the most deadly poisons. Therefore, the greatest care should be exercised in its use.

A Wallpaper Remover

THE difficulty and inconvenience incident to the removing of old wallpaper and the preparation of the wall for redecoration are reduced to a minimum by the use of a new tool that gets at the root of the trouble. It works under the paper, or, rather between the paper and the wall, softens up the paste or glue and freely strips the paper from the wall.

Every bit of wallpaper should be removed before beginning the work of repapering

It is particularly adaptable where there are several layers of paper to be removed, or for stripping off extra heavy or varnished paper. The usual way of flooding the walls with water or filling the room with steam are not necessary. The simple mechanical device illustrated generates steam on the spot with a gasoline burner and the steam is controlled by a valve in the hand-piece where it is driven behind the paper in a thin sheet.

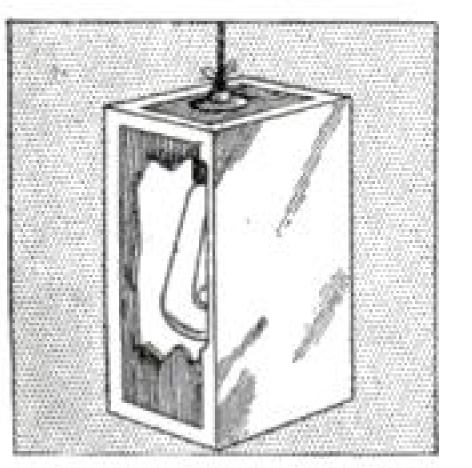
A Non-Spillable Funnel

A FUNNEL which will cease flowing automatically when the vessel into which the liquid is being poured reaches a certain height, can be devised by attaching a metal float to the tapering funnel-tip. The float is a small metal cylinder closed at both ends. Small brass tubes should be soldered on opposite sides of the float, as indicated in the drawing. Nails which will fit loosely in the tubes should be soldered at their points to the tip of the funnel, with the float in place.

When liquid is poured into the funnel, it will flow past the float until the vessel is nearly filled, whereupon the float will rise and check the funnel's discharge. The funnel can then be withdrawn quickly, so that little or no liquid is lost.

It is also advisable to use a funnel with a widely diverging rim to take care of the overflow. When the float is suddenly pushed up against the spout the liquid begins to rise in the funnel, making this necessary.

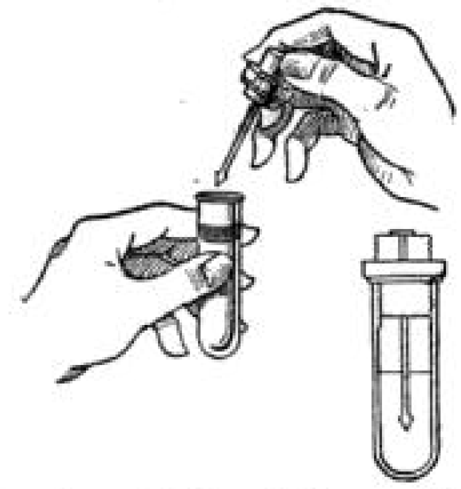
A Dark-Room Lamp



A VERY handy dark-room lamp can be made from a cigar box. After tearing off the cover, cut a hole in one end just large enough to allow it to be slipped over an electric light bulb and porcelain receptacle. Paste ruby paper over the opening. A fifteen-watt lamp will not be too bright.

When the room is to be darkened, this is put over the light. When not it is simply left off. With this, one can get along with one light in the developing-room.

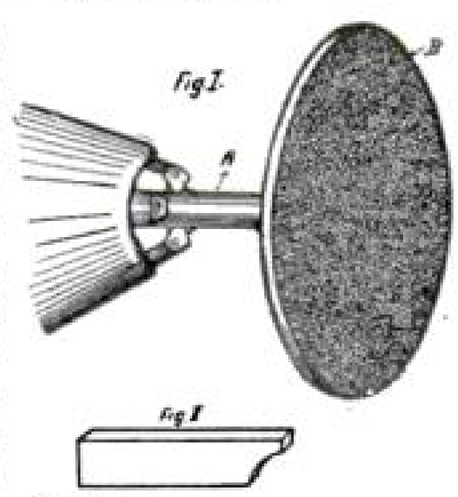
A Handy One-Drop Oiler



A VERY useful oiler made from materials to be found in nearly every box of odds and ends is here shown.

The oil container is a dust cap from an old automobile tube. A ½-in. plug is cut from an old valve-stem and a washer fitting this plug is soldered to it at the center. A six-penny nail which will fit the hole in the plug is soldered in place and flattened at one end. A leather washer should be made for the plug and the oiler is ready for use. This oiler will be found handy around the house as well as in the garage.—F. W. NUNENMACHER.

Rubbing in the Lathe



THE writer had a number of pieces of cast-iron to be filled with machine filler after which they were to be rubbed smooth and flat. Rubbing by hand was slow and the surfaces hard to flatten.

The cut shows the fixture used for rubbing; it worked very successfully. The shank *A* Fig. 1, is held in the chuck of the lathe and the face *B*, turned flat. To the face *B*, a piece of coarse emery cloth is glued and the "rubber" revolved at a fairly high speed. The work is held by hand against the revolving "rubber" until the desired results have been obtained, after which they are finished by hand, rubbing with fine emery cloth.

After the emery cloth has been glued to the "rubber," it should be placed face downward on some flat surface and weighted down. The kind of work for which this fixture was used is shown in Fig. 2.

The bed of the lathe should be covered to keep the emery away from the bearing-surfaces.—C. ANDERSON.

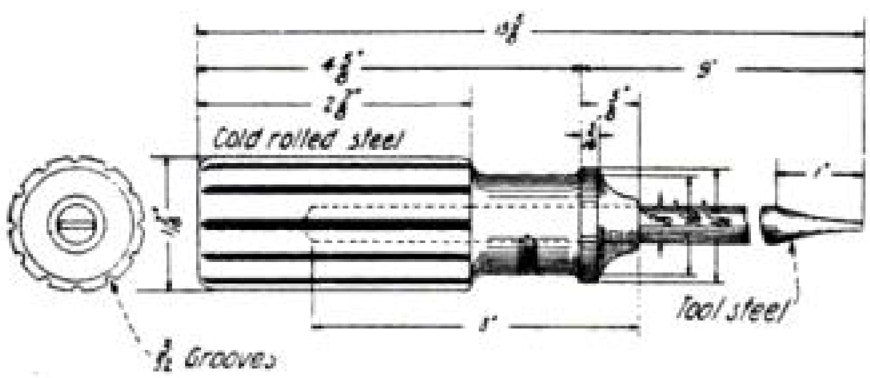
An All-Steel Screwdriver

THE screwdriver to be described is constructed entirely of steel and while feeling heavy at first will be found to be very well balanced and able to stand hard usage. If the blade is broken it can be easily repaired or replaced or different sized blades may be used.

The whole tool, including the fluting of the handle, was made on a small back-geared lathe with a hand-fed carriage.

A 5″ length of 1½″ cold-rolled steel shaft was cut off and a 3/8″ hole 3″ deep bored in the center of it to take the blade. The handle was then roughed out nearly to the finished dimensions and a light finishing cut taken all over it at high speed.

The handle was fluted as follows: The circumference of the large end was



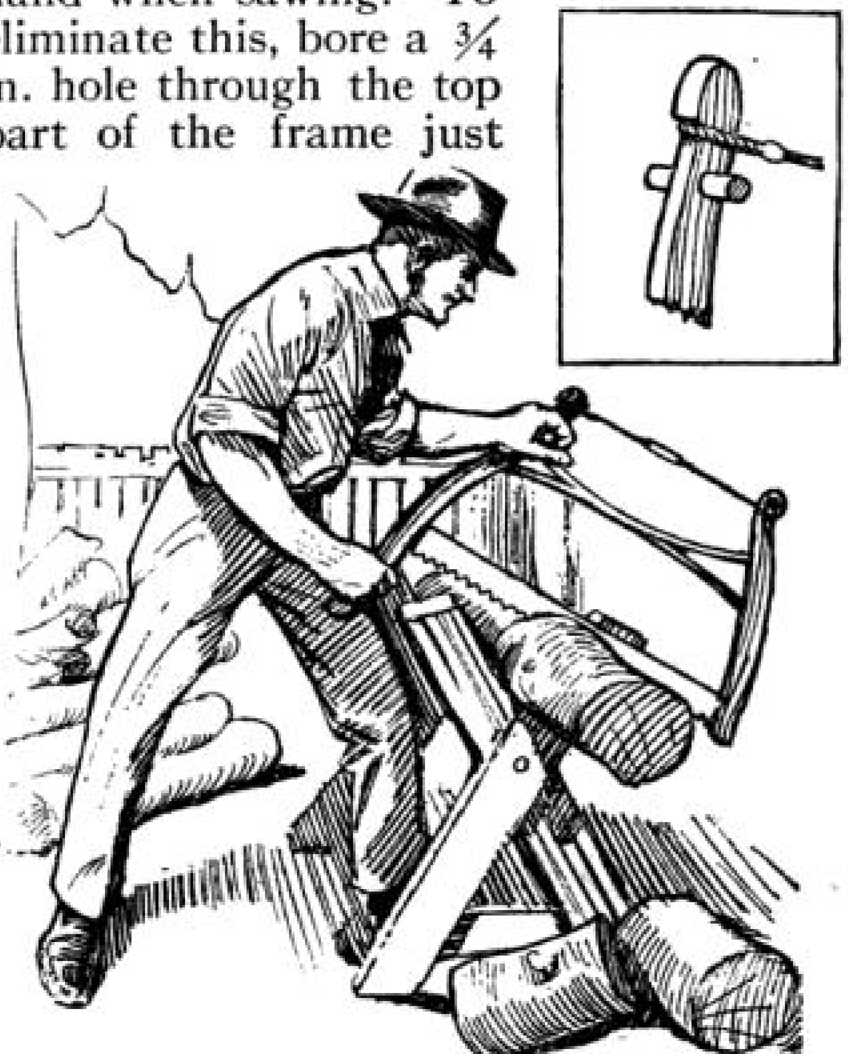
A screwdriver made entirely of steel

divided and punch-marked into twelve equal parts. Then a hole was drilled and tapped for a ¼″ set-screw in the small part of the handle, as shown in the drawing, and a length of 3/8″ rod set in and countersunk for the set-screw. The outside end of this rod was held in the lathe-chuck, the large end of the handle being held in the back-center. A steel lathe-tool with a small rounded end, was placed in the tool-post turned over on its side; the lathe-chuck was kept from turning by locking the back-gears, and then each groove was cut by moving the carriage along by hand and taking a succession of light cuts until the groove was of the required depth.

The blade was made of a piece of ⅜″ tool steel with the tip end hardened and was held in the handle by means of the ¼″ set-screw, countersunk about ⅛″. A set of blades could be made of different lengths or with tips of different widths.

A Buck-Saw Attachment

THE ordinary buck-saw frame has a tendency to cramp the upper hand when sawing. To eliminate this, bore a ¾ in. hole through the top part of the frame just

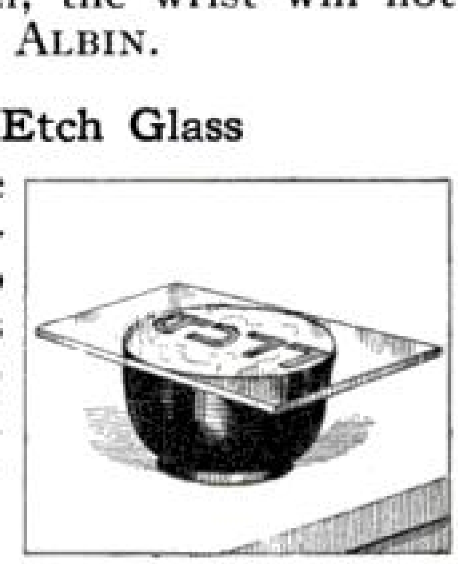


A simple peg makes the task of sawing wood a little less strenuous

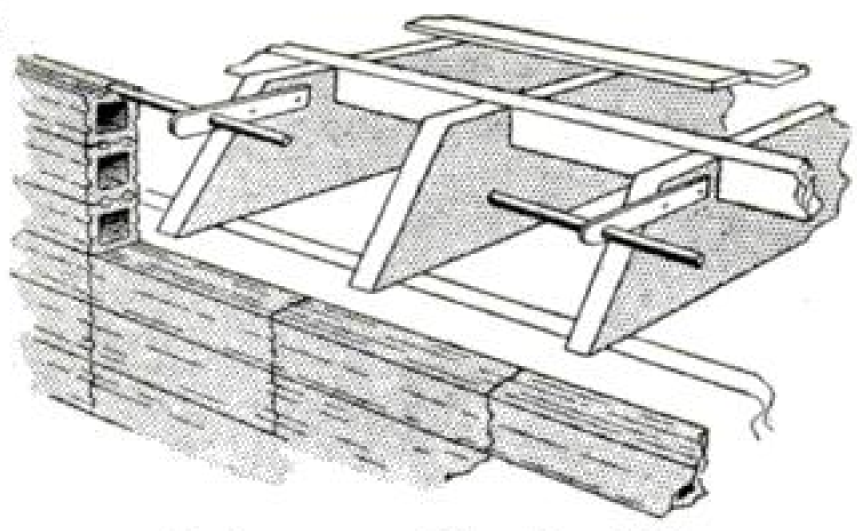
below the tightening wire. Cut off a piece of an old broom handle 4 ins. long and drive it through this hole half projecting on each side. By gripping this pin with two fingers on one side and two other fingers on the other side, with the saw frame between, the wrist will not be twisted.—W. J. ALBIN.

How to Etch Glass

WARM a piece of glass carefully; if heated too rapidly the glass will crack. Rub paraffin or beeswax over the warm surface of the glass. With a blunt instrument print the desired wording. To some fluorspar (calcium fluoride) placed in a metal dish, add enough concentrated sulphuric acid to moisten the powder. Place the glass, with the marked side down, over the metal dish containing the above chemicals and leave it over night. In the morning, scrape the paraffin off and the desired words will be etched on the glass.



The fluoride bath



A clever way of bonding joists

Bonding Joists to Brick Walls

THE illustration shows how it is best to bond joists to hollow tile walls in the building of residences. A piece of 1/4-in. by 2-in. strap-iron is spiked to the joists as shown. The outward end has a hole bored through it and holds a 1/2-in. steel rod that is 10 ins. long. This rod fits into a groove in the top side of the tile in the mortar joint.

This scheme makes a solid connection between the floor joists and the hollow tile walls.—W. E. FRUDDEN.

Emergency Control of Motor

A METHOD is herewith illustrated for stopping a motor at will from any part of the shop. When the push-button is pressed the circuit is open and the lever will fly back, stopping the motor. A number of these buttons connected in series may be used, one by each machine. Should anything happen to the operator the button could be pressed and the motor brought to a stop at once. In the construction of the push-button a spring keeps the disk in contact.—FRANK HARAZIM.

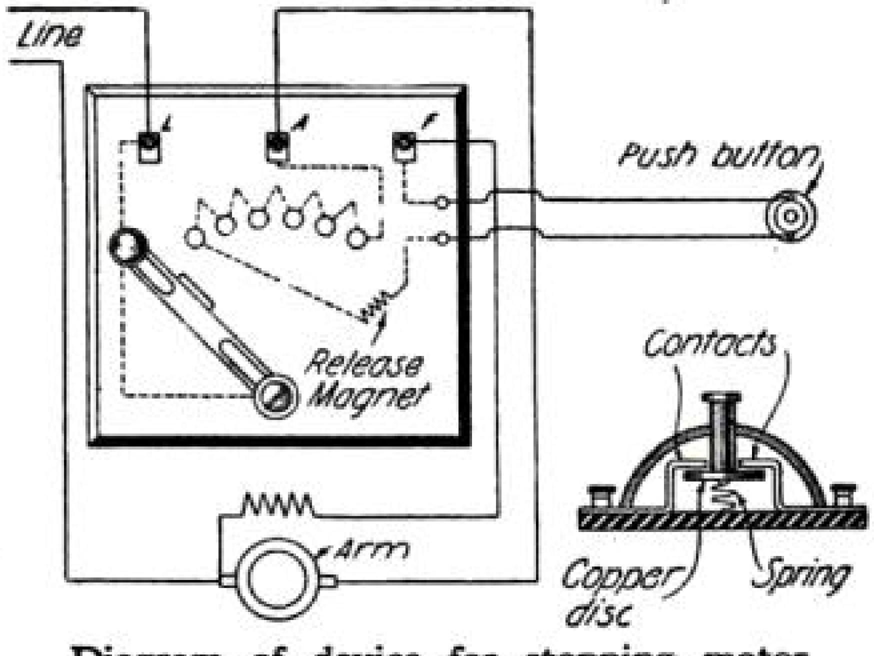


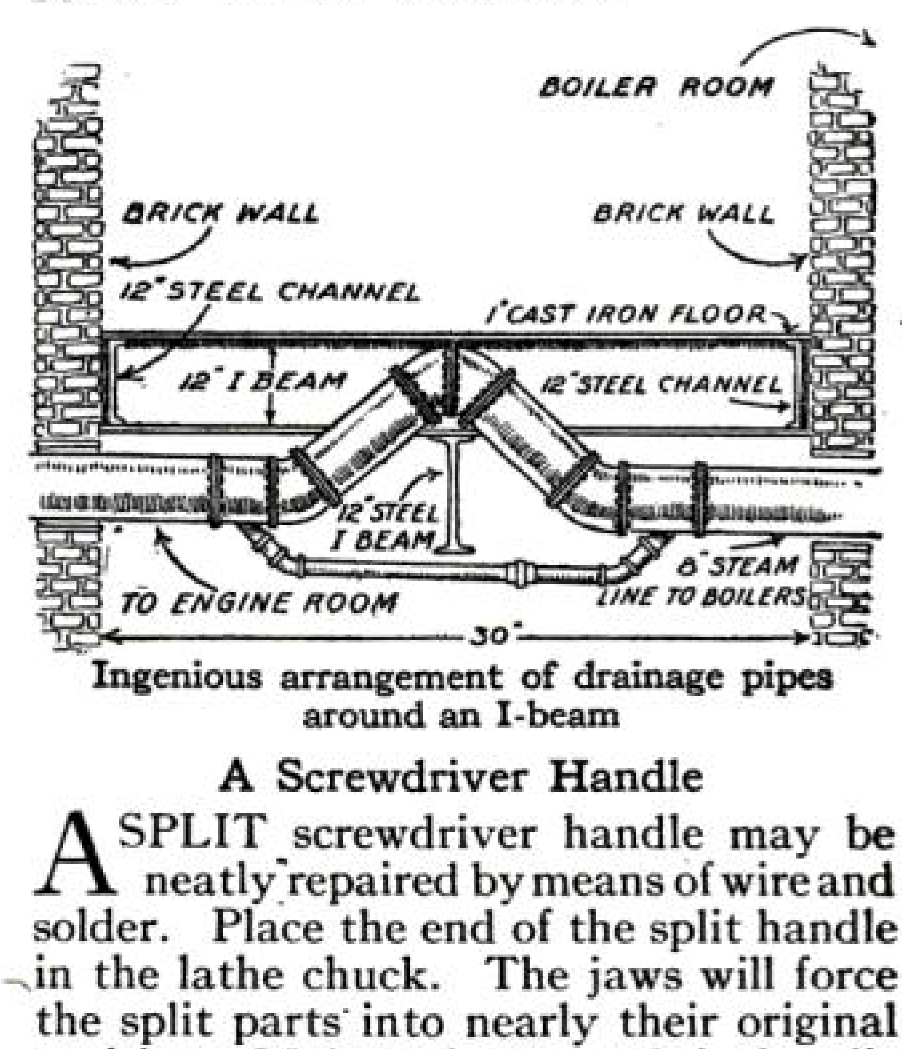
Diagram of device for stopping motor from any part of shop

A Drainage Kink

IN the installation of an 8-in. steam line, using present headers and steam openings in a steel and brick building used for gas-making purposes, it was found that to place the line with least expense and to drain back to the boilers, a 12-in. I-beam was in direct line.

To go over or under the I-beam meant a trapped line and use of a steam trap. To avoid the use of a steam trap and take care of condensation the connection was made as shown below.

An 8-in. line was installed using 45-degree bends over the I-Beam and a two-inch drain line underneath the I-Beam. The two-inch line takes care of condensation and gives drainage back to the 8-in. line which in turn drains to boilers.—W. W. FLANDERS.



Ingenious arrangement of drainage pipes around an I-beam

A Screwdriver Handle

A SPLIT screwdriver handle may be neatly repaired by means of wire and solder. Place the end of the split handle in the lathe chuck. The jaws will force the split parts into nearly their original position. Make a slot around the handle wide enough to take four or five turns of wire and deep enough so the wire will be below the surface. If a lathe is not available, the handle may be held in a vise and the slot cut with a knife.

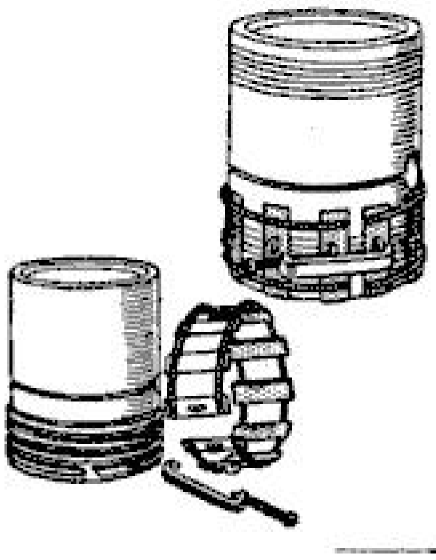
With a hand drill, make a hole near the slot in which to start the wire. The hole should be as nearly the size of the wire as possible. Wind the wire on tightly. Holding the end with pliers, cover the wire with solder, forming a solid metal band. Smooth the solder with a file, and the screwdriver is as good as new.—B. H. LIBBY.

Automobile Shop Repairs

Replacing Automobile Piston-Rings

WHEN replacing the piston in the cylinder of a gasoline engine, after it has been taken apart, it is usually difficult to get the compression-rings to enter the bore because they have to be sprung shut one at a time in order to slide in. A new device has been designed to obviate this difficulty. It is formed of two flexible steel cables connected by a series of steel bars, the last bar on one end and several bars on the other end being fitted with lugs.

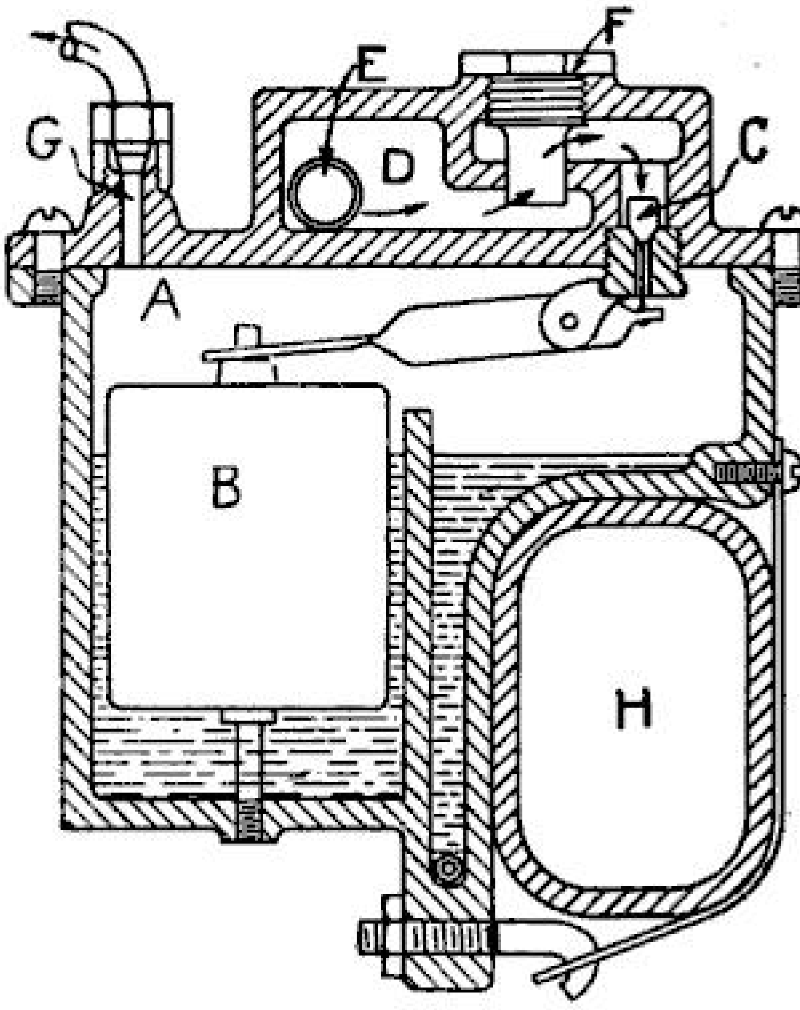
The method of using the device is to wrap it around the rings of the piston, after which a small clamp is placed on the proper lugs and screwed up until the rings have closed tightly around the piston. When the piston is slipped into the cylinder the contrivance is pushed off the rings as they enter the cylinder in succession.—E. G. INGRAM.



The difficulty of replacing the piston in the cylinder of a gasoline engine can be facilitated by means of a series of steel bars which are arranged as shown

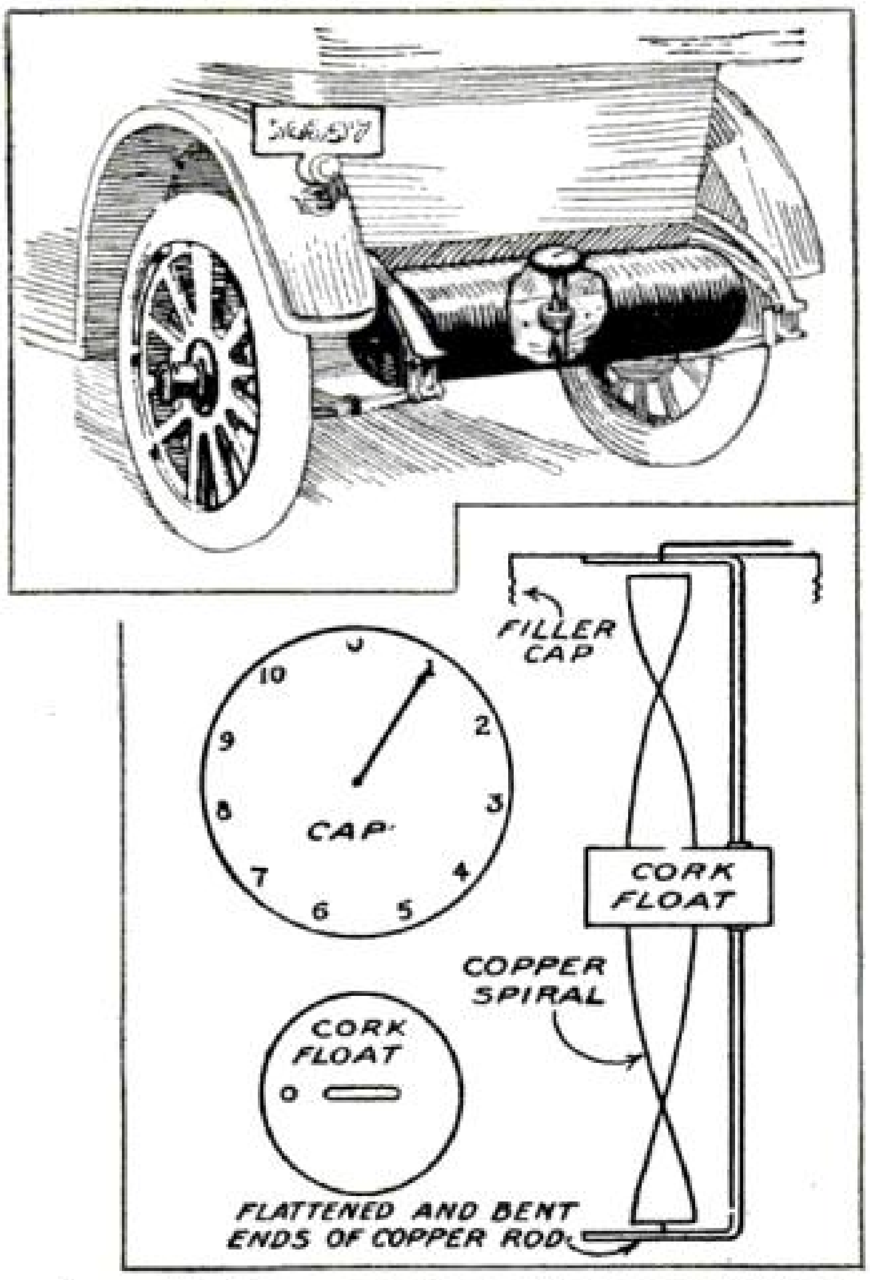
Steam as a Carbon Remover

FOR a number of years certain tractor manufacturers have been able to use kerosene as a fuel by injecting a small amount of water in it. The water flashed into steam from the heat of the explosion and reduced carbon deposits that would otherwise form in the combustion chamber. A small steam vaporizer has been devised recently for use with gasoline automobile engines which makes the admission of steam into the firing-chamber an automatic process. The device is shown in accompanying-illustration. The water-container *A* carries a float *B* and a float-regulated-water-admission valve *C*, and is designed to be clamped around the exhaust-manifold. The cover contains a chamber *D* into which water passes through hole *E* from the water-jacket around the cylinder-head. Hole *E* is connected with the water jacket by a pipe and unions. There is sufficient pressure due to head of water in the radiator to force the water through the pipe to *E*, then up through the filter to the orifice controlled by the float-valve *C*. The steam generated in chamber *A* by the heat of the exhaust-pipe is drawn out through pipe *G*, which communicates with the induction pipe above the carburetor.



Steam vaporizer for reducing carbon deposits in combustion chamber

A certain quantity of steam or water vapor is mixed with each ingoing charge and the engine not only develops more power, owing to an increase of the mean effective pressure of the explosion, but the oxygen gas liberated by the breaking up of the steam keeps the engine clean by combining with excess unconsumed carbon. It is doubtful whether the small amount of steam drawn into the mixture can make any appreciable difference with the power developed, but it is a known fact that introducing water vapor in proper quantities will tend to reduce liability of carbon deposit in the combustion chamber.—VICTOR W. PAGÉ.



A practical home-made gasoline gage for the automobile

A Gasoline Tank Gage

A GASOLINE tank gage may be made as follows: Obtain a brass rod of about 3/16-in. diameter, 2 ins. longer than the tank is deep, a cork about 1½ ins. in diameter and ¾ in. thick; also a strip of copper ½ in. wide, about 1/16 in. thick and as long as the tank is deep. To make the holes in the cork-float, obtain an iron rod and a piece of strap-iron of the right size, heat them and press into the cork. Repeat this operation until the holes are burned through the cork.

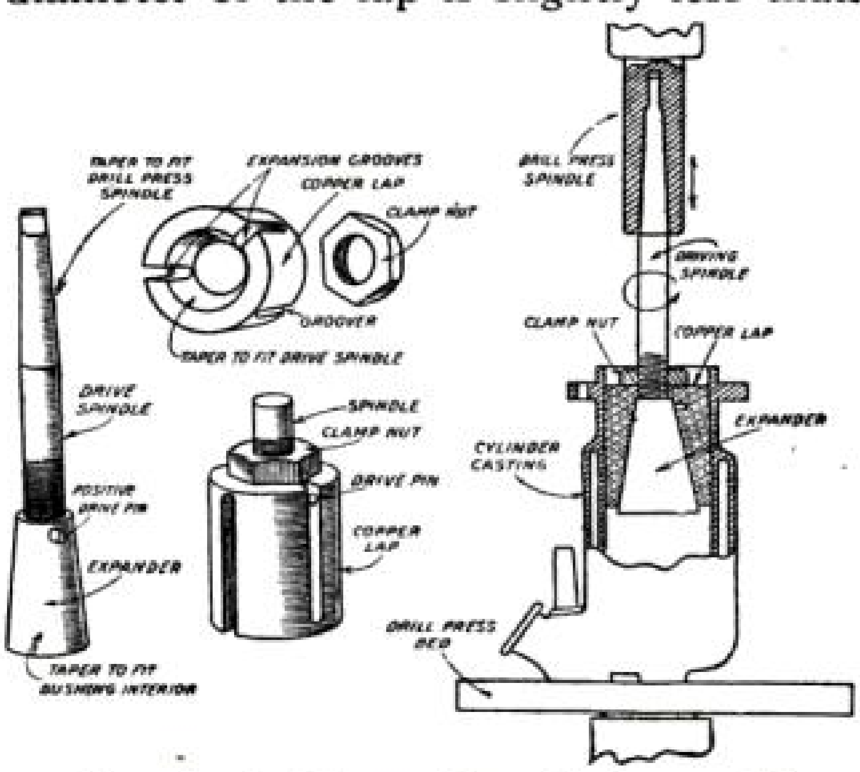
Put one end of the copper strip in a vise and with a pair of pliers give it one complete turn. See that the float slides freely upon it. Place the float on the brass rod and flatten the ends of the rod for a distance of 1 in. and drill holes for copper or brass wire to be soldered to each end of the copper spiral for bearings and pointer. Assemble as shown in the illustration. Make a hole in the filler-cap to accommodate the pointer and solder the upper end of the brass rod to the cap.

The float should be given two coats of shellac. Make a zero mark on the filler cap where the pointer stands, when the tank is empty. Pour in one gallon of gasoline, put the gage in place and mark a figure 1 where the pointer stands, and so on until the tank has been completely filled.—CLAUDE M. SESSIONS.

Lapping a Scored Automobile Engine Cylinder

SOMETIMES an automobile engine cylinder will become scored due to defective cooling or lubrication, or on account of dirt in the oil. This results in loss of power, because the compression in the cylinder is reduced by escaping gas. If the scratches are not too deep, they may be lapped out and the expense of re-boring the cylinder saved. A very simple yet effective lapping-tool is shown. A main spindle of mild steel carries a tapered expander-plug, which fits a corresponding taper in a cast-copper lap. This has four grooves cut in it, two extending from the top nearly to the bottom, two from the bottom nearly to the top. These permit the lap to expand when it is forced down on the expander-plug by the clamp-nut. A driving-pin is inserted in the spindle, this turning the lap because it fits one of the slots.

The scored cylinder is clamped securely on the bed of a drill-press and the lap inserted in the bore after it has been covered thoroughly with abrasive material, usually fine emery and oil. The diameter of the lap is slightly less than

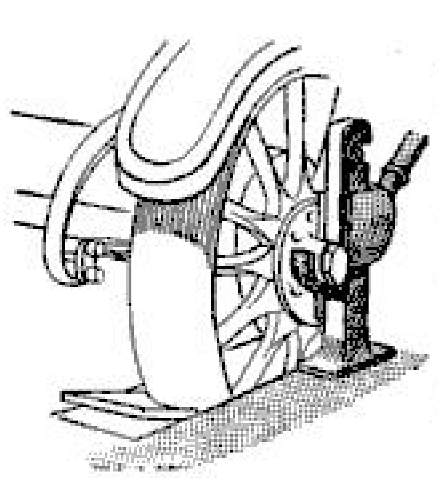


A lapping-tool for engine cylinders avoids the necessity of reboring

that of the cylinder before it is expanded by the clamping-nut. It is turned to have a very smooth surface. In use, the drill-press is set in the back gears so the spindle will rotate slowly, while the lap is revolving. It is also raised up and down by the hand-feed lever. The lap may be expanded slightly after it has been turned and reciprocated for a time and fresh abrasive added. Care should be taken to clean all emery and oil out of the cylinder when the lapping process is completed. If the work is properly done, all the scratches will be eliminated and a smooth bore secured. Deep scratches, such as caused by a loose wristpin, can only be eliminated by re-boring the cylinder.—Victor W. Pagé.

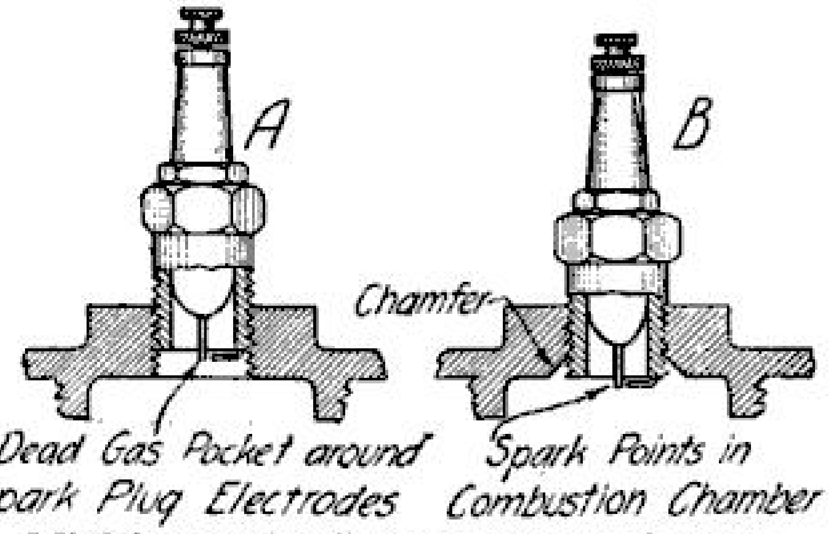
A Handy Hook for the Automobilist

A HANDY and cheap attachment for an automobile-jack is an iron hook that can be made by any blacksmith. It should be just a little shorter than the jack, with one end bent to fit over the top of the lifting head and the other end formed into a hook large enough to hold an axle, and strong enough to lift the car. In this way, the machine can be easily raised in places where it is impossible to set up the jack in the usual manner, for lack of clearance. The hook will be found particularly valuable when the automobile gets stuck in the mud and there is no pry available. In this situation there is never sufficient clearance to use the jack, but with the hook, the car can be raised far enough to get a board, a box or some dry dirt under it.—E. F. Ayers.


A useful hook

Simple Cure for Misfiring at Low Engine Speeds

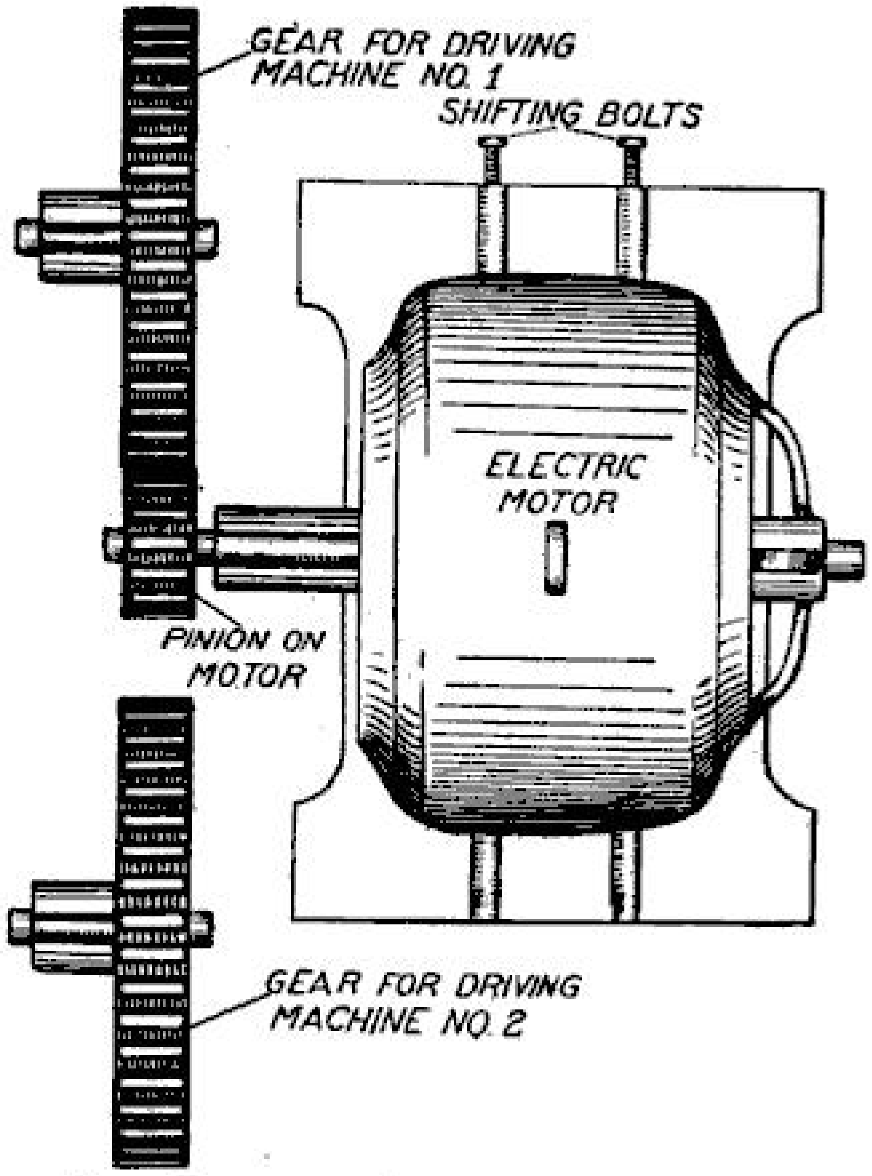
THE writer recently cured a case of misfiring at low engine speeds by a very simple expedient. The engine was a comparatively new one, and had not been run long enough to ascribe the trouble to wear in the inlet valve stem-guides. All manifold joints were tight, and there was no air leak around valve-caps or petcocks. The carburetor adjustment was altered without receiving any benefit. A good spark was obtained from both battery and magneto systems, and as the misfiring was as pronounced with one ignition system as the other, it plainly was not the fault of the ignition group. The misfiring was not serious but annoying, especially when running the engine slowly on the direct-drive in traffic.



Misfiring can be eliminated by tapping out the valve-chamber caps

In removing the spark-plugs to experiment with various gaps between the electrodes, it was noticed that the plugs did not screw into the cap very deep and that there was a pocket in the valve-cap beneath the spark-plug, as shown at *A* in the accompanying illustration. As everything else had been tried without curing the trouble, the valve-chamber caps were tapped out with a ½-in. pipe tap so the plugs could be screwed in enough to eliminate the pocket entirely as shown at *B*, and the edges of the tapped holes were chamfered to make sure the plug would project into the large chamber in the valve-cap. After the parts had been replaced, and the carburetor restored to its original condition, all misfiring ceased.

The explanation is that at low speeds, owing to imperfect scavenging and low rate of inlet gas flow, some dead gas left from a previous explosion collected in the small pocket around the plug-points; when the spark took place, the ignition function was erratic because of the poor gaseous mixture surrounding the plug-electrodes. Bringing the points further into the combustion chamber eliminated this condition, because the electrodes were swept by the fresh gas at every intake-stroke.—Victor W. Pagé.



Plan of motor serving two drives. Turning a bolt makes the shift

One Geared Motor Serves Two Drives

THIS diagram illustrates a good method for making one geared motor serve two drives. Line up the two large gear-wheels No. 1 and No. 2, as shown in the diagram. Set the motor so that the motor-pinion falls between them. It must not engage both large gear-wheels at once. As shown here, the motor is driving machine No. 1. By simply turning the shifting-bolts (usually there is only one shifting-bolt on a motor), the power is quickly applied to gear-wheel No. 2 for driving machine No. 2.—N. G. NEAR.

A Pocket-Clip for Pencils

A CLIP for holding pencils and fountain-pens in the pocket can be made from a paper-fastener. One end of the fastener is straightened and wound tightly about the pen or pencil, while the other end lies flat in a lengthwise position.

A pencil clip is about the cheapest thing in the world to make

Building an Oil Reservoir

A SIMPLE and useful outfit for the storage of oil or other liquids is shown in the illustration. A one-hundred-gallon range-boiler is shown at *C;* 1 ¼-inch air-pipe is connected to the simple pump shown and to the top of the tank (the unions *A* and *B* are of the ground-faced kind so that the pipes can be disconnected and laid aside when not in use). The oil barrel *G* is rolled into place and blocked with pieces *H* and H^1, the bung removed and the one-inch pipe connected as shown. The valve *E* is closed, of course. By working the hand-pump the air in the tank will be removed and the oil will flow in to take its place. *D* is an ordinary water-gage. An enlarged view of the pump is shown in Fig. 2. It is made from an ordinary bicycle pump. Note that the leather cup is reversed as at *I*. Two ½-inch check-valves are soldered over holes made in the pump body, since it is imperative that the valves be absolutely airtight. The hard rubber composition-washers should be replaced with soft rubber ones. In using the pump the plunger should be forced right down to the bottom.—JAMES E. NOBLE.

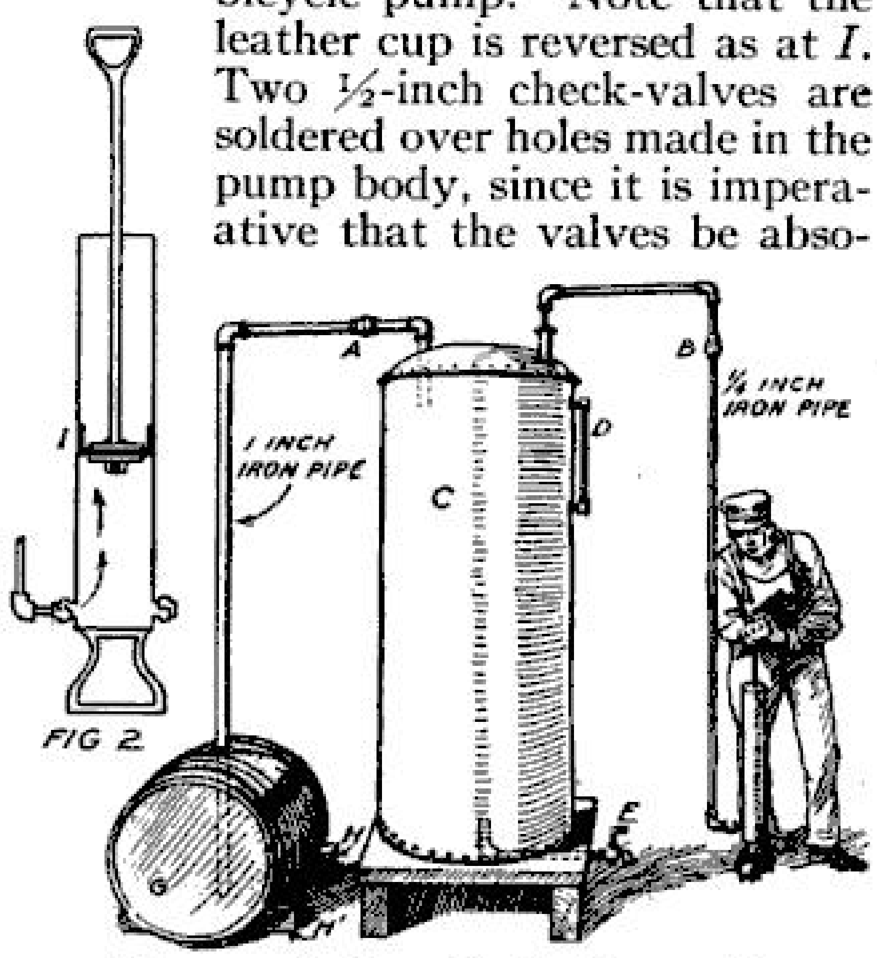


Diagram of a home-built oil reservoir

Emptying a Bottle

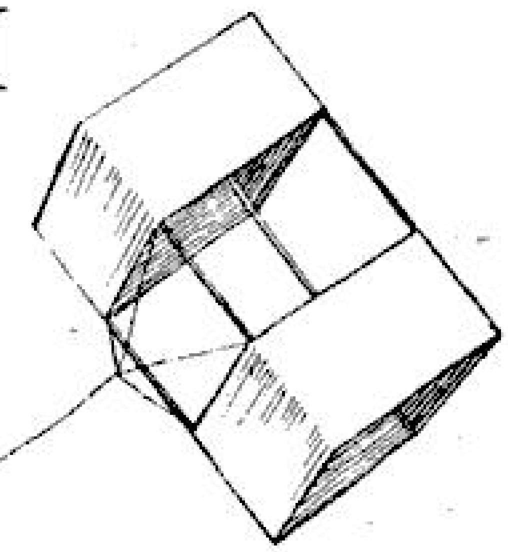
THE contents of a bottle may be emptied, drop by drop, if a match stick bent to form a figure 7 is inserted, by the long end, in the bottle, and held in place. The liquid then runs along the match stick, when the bottle is tilted, and drops off the end of the stick.

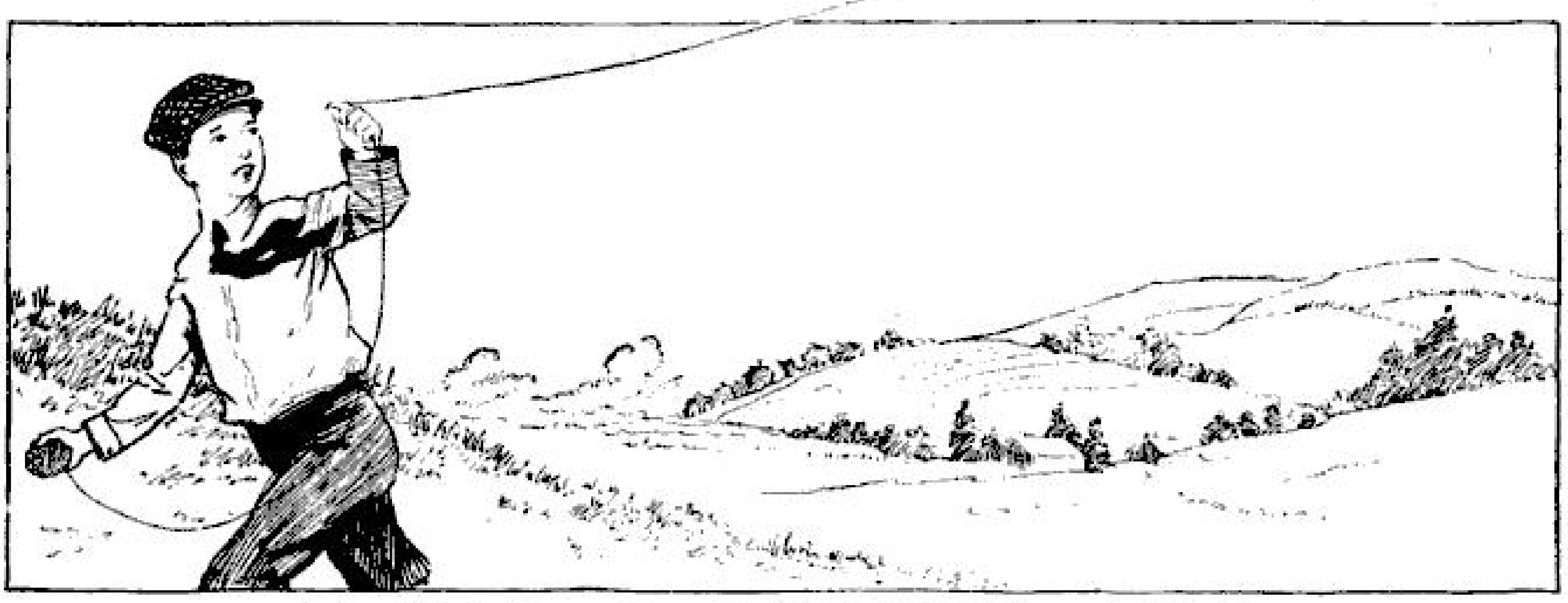
Kite Making at Home—II

How to Build and Fly the Blue Hill Box, Malay Box Combination and Tetrahedral Cell Kites

By H. S. Rinker

(Concluded from June issue)





A box-kite is the most practical to build and the easiest to fly

HAVING progressed thus far, variety can be introduced by making some Blue Hill box-kites. These are named after the Blue Hill Weather Observatory, Massachusetts, where they were originated. They look like Fig. 16.

Make 4 sticks ½ in. square, but otherwise proceed as described for the Malay kite. All kite sticks *must* be worked out in this manner to assure the absence of cross or twisted grain. Otherwise they may fail when you least expect it, and make more trouble than if made right at first. Several ways of bracing have been used, but the writer has had best results from the one shown. Put the frame together as indicated in Fig. 18.

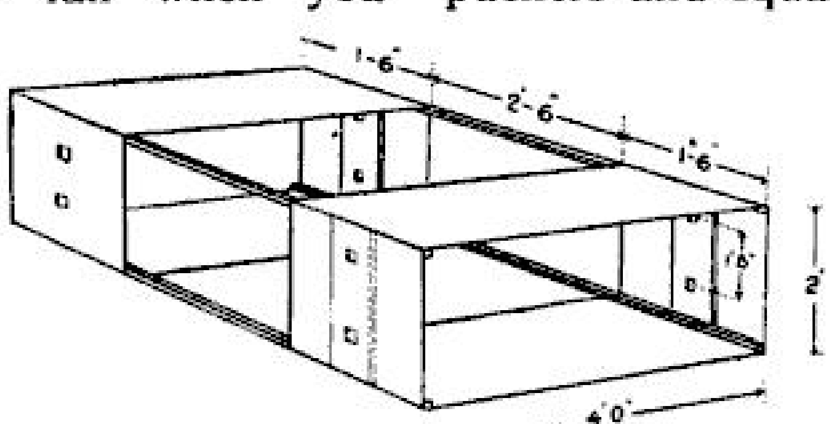


Fig. 16

Two of these side frames are needed for each kite. For bracing, nothing is better than a bamboo pole, about ¾ in. in diameter. Take a piece of this about 4 ft. 6 ins. long and rip it exactly in half, from each end until about 4 ins. in the middle remain uncut. Wrap this part with wire and solder. Then it will appear as shown in Fig. 19. Spread it out on your bench and hold with wire nails as illustrated in Fig. 20.

Now at points marked *A*, cut a shoulder, so that you can spring the brace into the holes in the hardwood strips. Take two strips of cambric 19 ins. wide and *hem both sides*, making them 18 ins. when hemmed. Pull out the puckers and square one end. Measure 12 ft. 1 in. and square the other end. Sew up with a half-inch seam. You now have two endless loops, each exactly 12 ft. long and 18 ins. wide. Glue the seam to the other sides of one stick. Slip the other side frame into the loop, put in the stretchers, adjust the sails smoothly, mark with a pencil, take down and glue. When knocked down this kite folds flat. It cannot be rolled.

The bridle is a loop of twine tied to the sticks at the inner margins of the cambric.

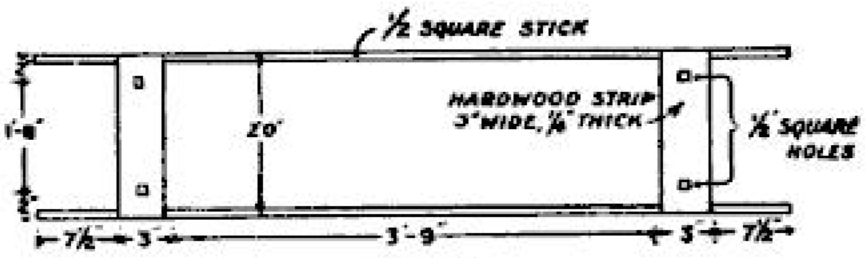


Fig. 18

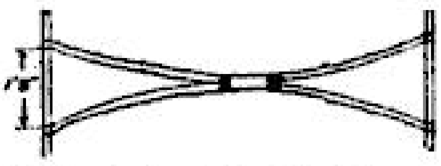


Fig. 17

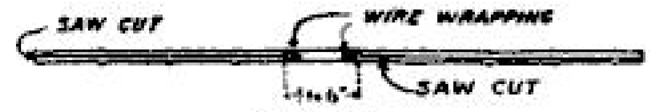


Fig. 19

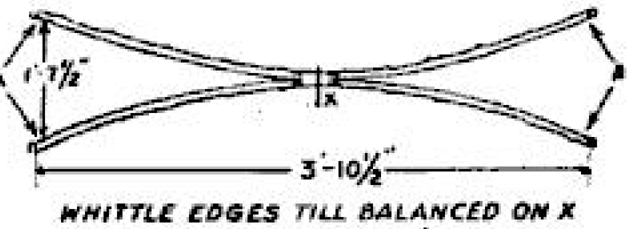


Fig. 20

Carefully find the exact center of the bridle loop and tie a loop knot there. This settles for all time the point of attachment of the flying string. This kite flies higher than the Malay kite, when bridled as described. By moving the bridle back carefully, a point can be found where the kite will fly low and pull like a mule.

The next type is the square box. It is shown in Fig. 21.

The directions for the Blue Hill box practically cover this, except the bracing. For this case place the hardwood strip vertically, glue and brace as before, with the differences shown. Cut the two holes side by side in the hardwood strip. Glue the spreaders to the side ribs, cut the shoulder on them at the right length, and spring into the holes. Bridle with a single string tied at the point where the inner edge of the cambric of one end crosses one stick. When knocked down this kite will lie flat.

The Malay Box Combination

This kite will add a large spread of

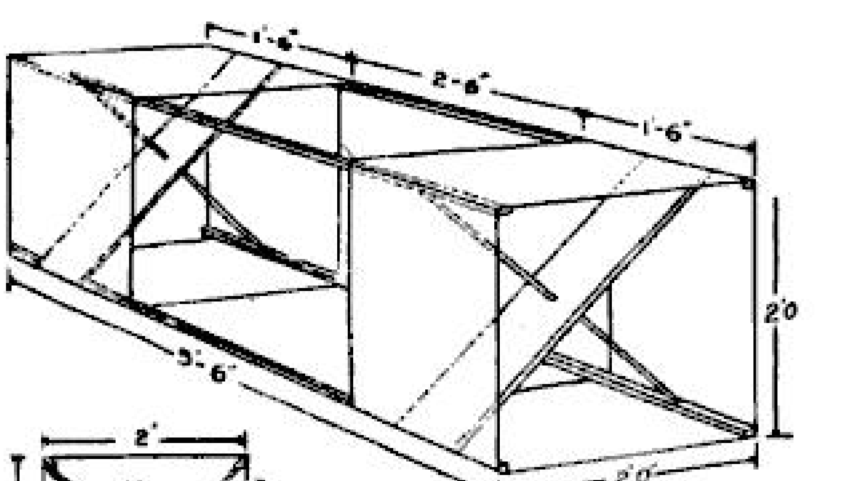


Fig. 21

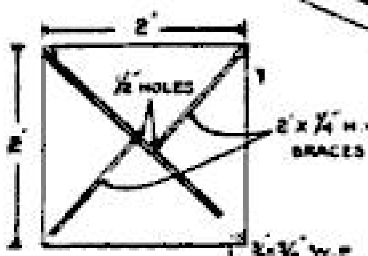


Fig. 22

sail to the kite described in the foregoing paragraph, by the addition of one stick. Make this stick 8 ft. 4 ins. long. Make it 1 in. wide by ½ in. thick. Notch the ends for the bowstring as described for the Malay. When put together it appears as shown in Fig. 23. This is exactly like two halves of a Malay kite, Fig. 24.

Make the bowstring stick so it can be dismounted, as described for the Malay. This kite is a beautiful flyer, and always attracts much attention when in the air. Three of these this size are all that can be safely handled at one time. This kite will knock down flat by removing the bowstring and bow. This kite, as described above has about 32 ft. of sail.

The Tetrahedral Cell

This kite is the invention of Professor Alexander Graham Bell, and is a scientific wonder. To begin with, a tetrahedron is a solid geometrical figure made by four surfaces, each of which is an equilateral triangle, all of these triangles being of equal size. A tetrahedral cell kite cuts out two of these triangles. The remaining triangles are the flying planes. In its simplest form

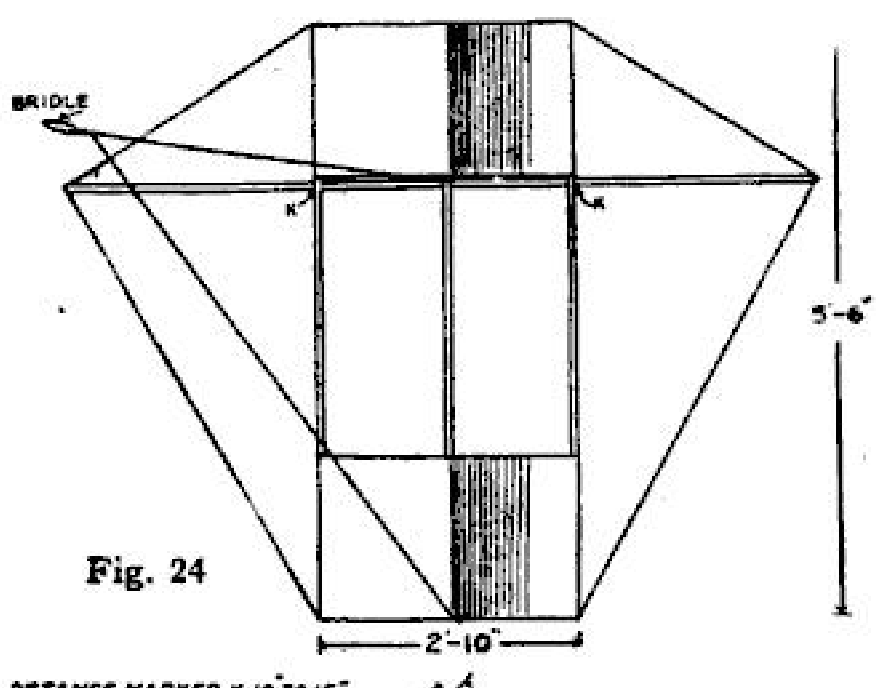


Fig. 24

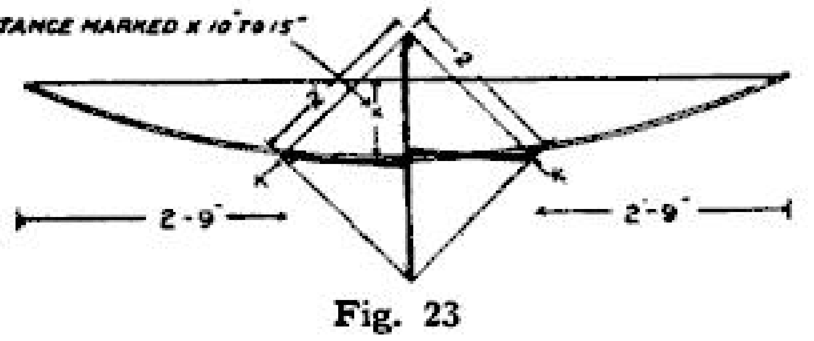


Fig. 23

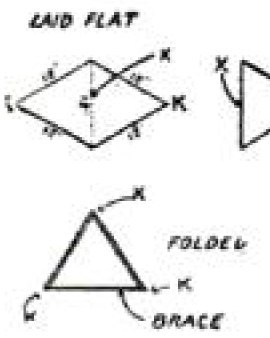


Fig. 26

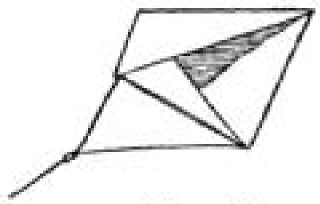


Fig. 25

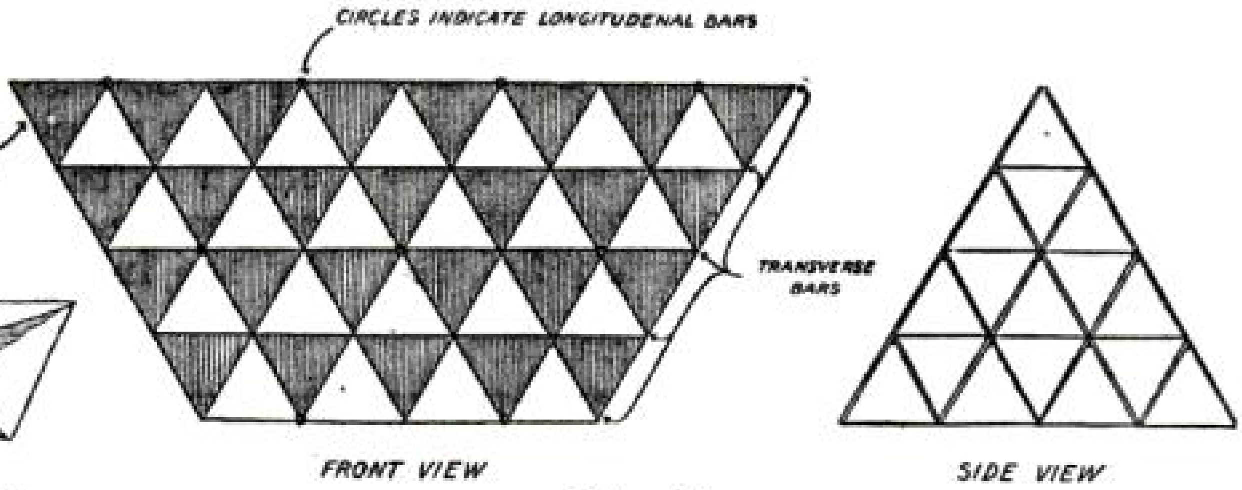


Fig. 27

it looks like Fig. 25. Opened out flat, it appears as shown in Fig. 26.

Now if we fold this on line *X* and connect points *K* by a brace exactly as long as one side of the triangle, we have a tetrahedral cell. Tie a bridle to it as shown. This kite has small surface for its weight, but it can be expanded by adding cells until it will carry almost any reasonable weight.

A large and complex tetrahedral is shown at the top of this page. Each cross represents one of the elements shown above, but now the frame work is composed of horizontal bars only. The transverse bars are shown between the rows of cells, and are so marked. The longitudinal bars are shown by the circles. Over this frame when tied together, very fine wires are stretched at the tetrahedral angle, and the cell surfaces are cemented to these. The surfaces in the kite here shown may be made of very tough Chinese rice paper. With the vertical supports shown, this makes a very light and rigid flying-frame. It is a good plan to start with a few cells and gradually increase the number as you build successive frames and become more expert. The cells can be arranged in any regular or fantastic figure as long as they are symmetrical about the keel.

Fig. 30

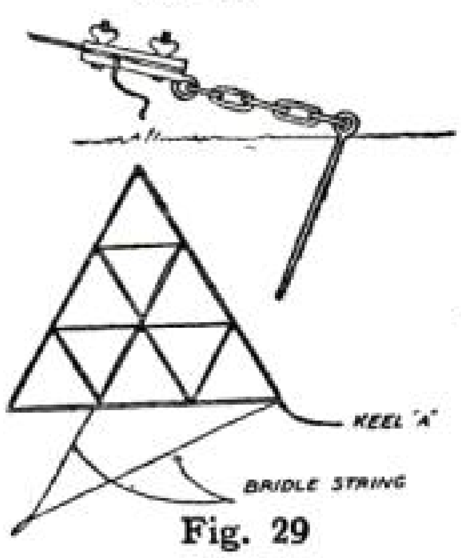


Fig. 29

The other 5 sticks should be of the same length, but made of stout bamboo, split about ½ in. wide. Whittle them till they balance nicely when hung inverted from the bottom stick. No other way of fastening can be used except lashing the intersections with fine copper wire or strong cord; braided fish line is good. Make it measure 3 ft. exactly. Every angle in the frame will now be exactly 60 degrees. Divide each stick into 3 equal parts, each one foot long. Take some fine copper wire (No. 28), and stretch it smooth between these division points. When it crosses, tie it with sewing silk or cotton thread lashing. This will make 9 divisions on any face. Set it so you look along the bottom stick, and cover every alternate triangle of wire that shows edge on to the front when you look at it in this position, with strong paper pasted on the wire. Tissue paper is good if strong enough to stand the strain. You should now have ten little paper V's, 3 on the bottom row, 1 behind the other, 4 in the center rows two and two, and 3 on the top, side by side. Looking down on the kite, it looks like Fig. 28.

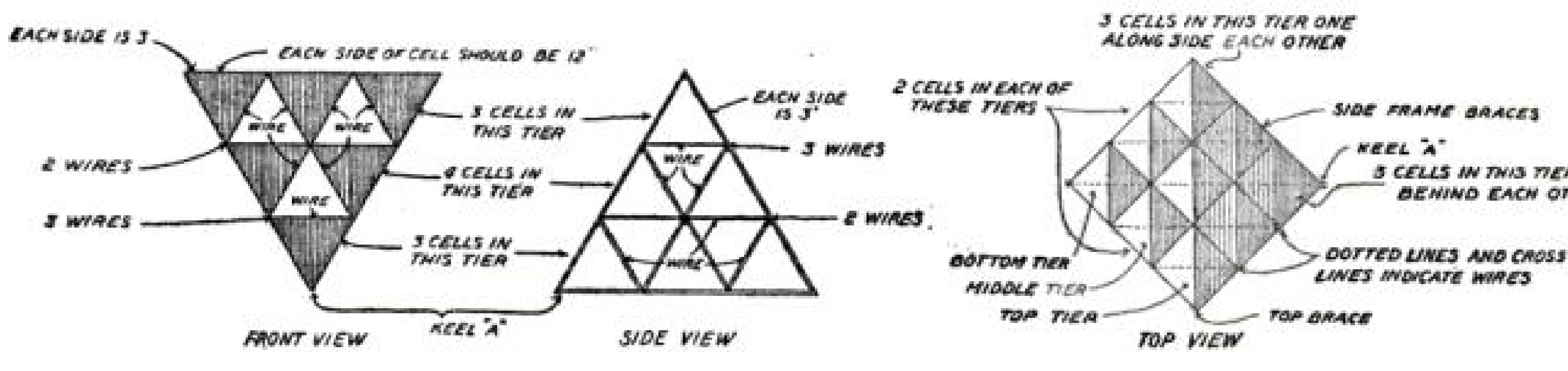


Fig. 28

Flying this kite will afford much pleasure. It is a most delicate and ethereal object at a great height, looking like a flock of soaring birds more than anything else. It is hard to make, but it pays its way when finally finished in the pleasure it gives its possessor.

A Few Words About Flying

Have a pair of gloves, duck or canvas with pieces of sole leather sewed in, to handle the flying line, if you use wire. The strain should never come on the reel. A clamp like this, made of cast-iron with two wing-nuts, should be used to clamp on the wire. A short piece of chain with a ½-in. rod at the end 15 ins. long is attached. The rod is pushed into the ground up to the eye, and the foot is held down on it to prevent its pulling up from the strain. The chain should be as strong as the flying wire. Of course if cord is used for the lower part of the flying wire, it can be handled by snubbing around the frame of the reel, or any convenient stationary object such as a fence post, fire-plug, chimney, etc., when a large battery is aloft.

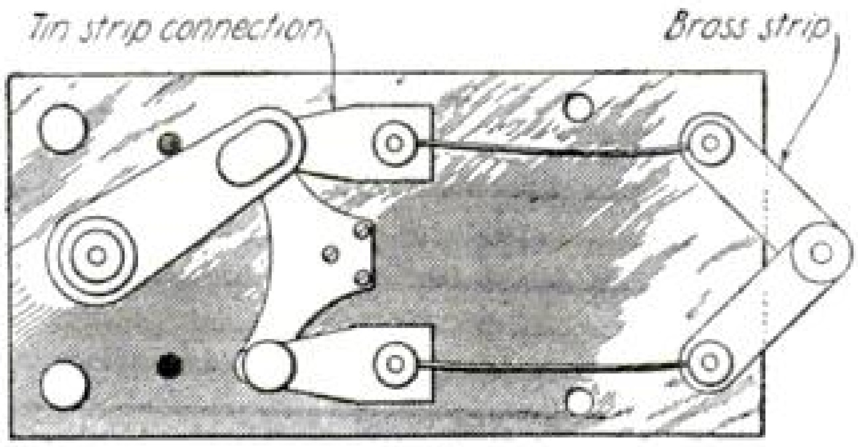
Smaller kites can be made by reducing the above proportions, and correspondingly lighter equipment can be used, If Malay kites less than 3 ft. high are used they can be covered with paper. although, owing to the imperfect pocket, the headsail action is not so pronounced, and the kite does not fly as steadily as one with cloth sails.

An Emergency Fountain-Pen

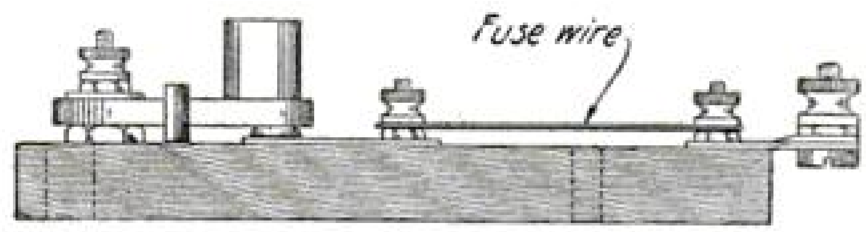
SELECT two pen nibs of the round variety and place them together, one above the other, in the penholder. This expedient not only enables one to write about sixty words with one dip in the ink, but prevents the ink from dropping off the pen and blotting the paper.—W. LUHRS.

Making a Two-Fuse Switchblock

TO obviate the annoyance of fitting up a new fuse when one has blown out, a switchblock may be made, which carries two fuses. A block of fiber, ½ in. by 1⅜ in. by 3 ins. is used as a base. Drill two holes 5/16 in. away from each end and ⅜ in. from each side, large enough to take a 4-32 bolt. Drill the same size hole in each end of two thin strips of brass, 1 in. by ¼ in. Pass one end of each strip over the bolts and bolt the other ends with two nuts, one underneath and one above the strip. Leave the bolts long enough to receive battery post nuts. The end of the block just prepared is used as one binding post, the details being shown in the diagrams. The other ends of the strips are bolted tightly to the base, the bolts being long enough to receive battery post nuts. These bolts are to act as the terminals of the two fuse wires.



A small convenient switchblock for accommodating two fuses



If one fuse blows out simply switch over to the other fuse

Two more holes to take 4-32 bolts are drilled 1½ ins. from either end and ⅜ in. from either side of the block. After placing the bolts in these holes, a strip of copper or tin is hammered over them and fastened down with brass screws. File down the screws to form a smooth surface. Another hole for a 4-32 bolt is bored 5/16 in. from the end, as shown in the diagram. A piece of brass, 1 in. by ½ in. by ⅛ in., is bored at each end with a 4-32 drill, and slipped over a bolt of the same bore. A block of fiber, ½ in. by ½ in. by ½ in., is bored with a 3-32 drill and forced over the bolt. The bolt is then pushed through at the other end.

A nut is placed between the fiber base and the bar to allow for the thickness of the two contact screws and the head of the nut at the other end of the bar. A double set of nuts are used to hold the nut tight. At the top of the bolt is another battery post nut to be used as the other terminal.—L. A. KUEHNE.

Experimental Electricity

Practical Hints for the Amateur

Wireless Communication

The Construction of an Improved High-Tension Audion Battery

By Charles Horton

IN the early days when the audion as a detector was used only to a limited extent, it was generally considered that on account of the extremely high resistance of the path through the telephones and across the vacuum in the bulb, the high-tension battery used to supply this circuit must be good for many years' work. But since the audion has been manufactured and placed on the market and its use has become widespread, it has been found that sometimes the dry cells used for the high-tension battery suddenly seem to lose their voltage in a most unaccountable way and have to be renewed.

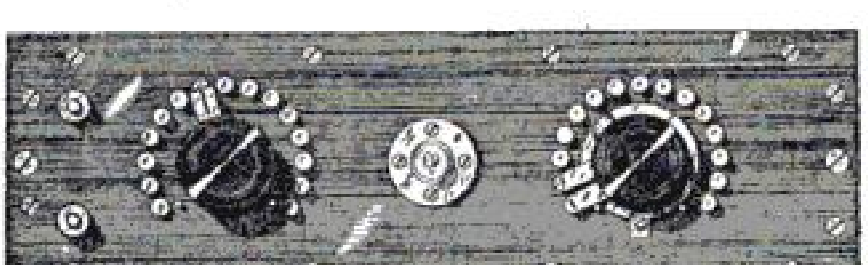


Fig. 1. Showing the arrangement of switches on the case

It has been noted by many experimenters that only certain of the cells become "dead" while the others are apparently as good as when installed. When the audion set refuses to work, therefore, it becomes necessary to test each cell of the high-tension battery, which is a tedious job; and, since the terminals of the cells are usually soldered

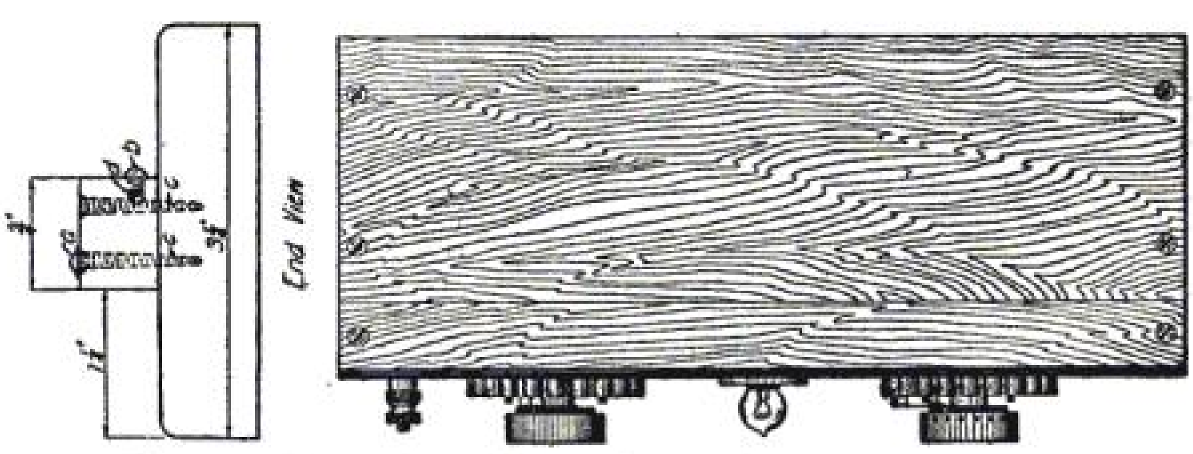


Fig. 2. Two other views of the switch arrangement

to their leads, the replacing of one or more cells is a lengthy and unpleasant operation. In order to make the cells easily accessible, it is now customary to mount them in a box separate from the audion proper, this box having on one panel the usual high-tension switch and two binding posts from which wires lead to two other posts on the audion cabinet.

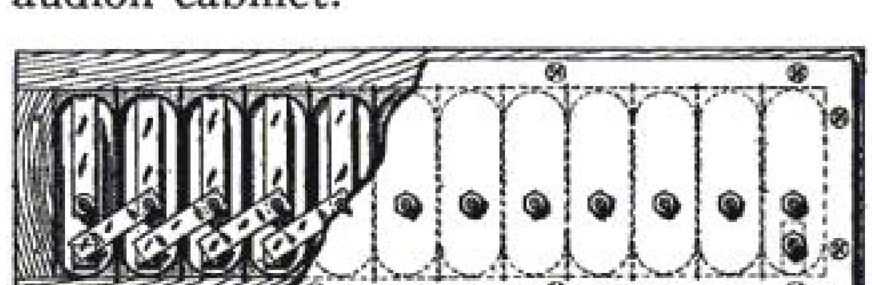


Fig. 3. View of the case with the front panel removed

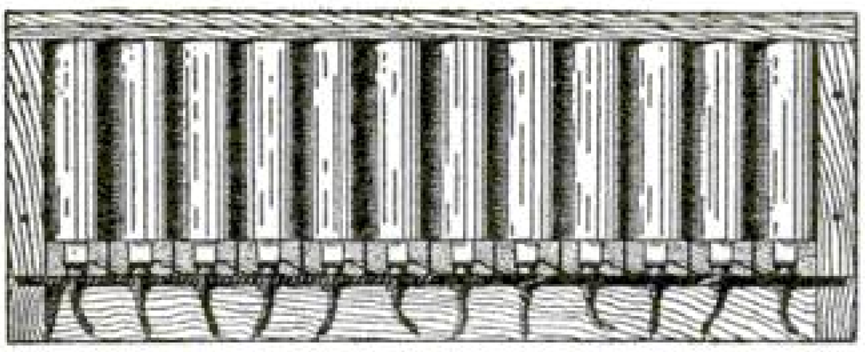


Fig. 4. Another view of the interior of the cabinet

In order to overcome the disadvantage mentioned above and also to eliminate the necessity of soldering the cells, the writer designed a battery case in which the cells are slipped in place from the back and automatically make connection. There is also provided an extra switch mounted on the case which allows each cell to be tested out individually at any time, in a most convenient way.

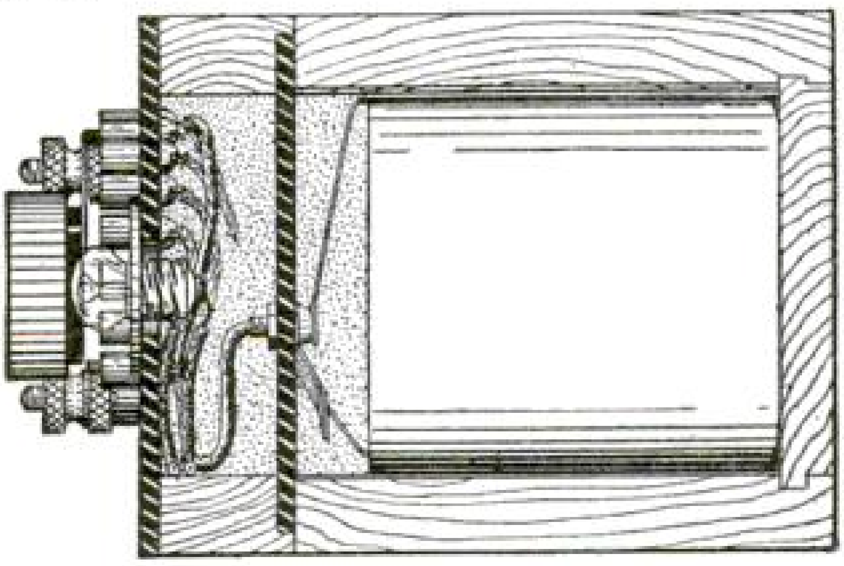


Fig. 5. Sectional view of case taken through testing-lamp

The arrangement of switches on the case is shown at Fig. 1 and Fig. 2 of the accompanying diagrams. In Fig. 1 there will be seen to the left of the panel at the front of the case the usual high-tension switch. This is of the type recently described in this magazine, and in which, to prevent accidental short-circuiting of the cells, there is provided between each pair of live points an extra point. All of the extra points are connected together and act in place of the usual connection to the center of the switch. The points are so spaced and the width of the lever so calculated that the lever cannot in any case cover more than two points, thus making connection but preventing short-circuiting.

The spacing of the points is also such that the switch is smooth and noiseless. The method of connecting is shown in the diagram on page 134. At the right of the panel is shown the testing-switch, the two levers of which are connected to the lamp shown at the middle of the panel. The first two points of this switch, upon which the lever is shown at rest, are arranged to be "dead;" each of the other points is connected with the corresponding point on the other switch. Thus when the testing-switch is turned and its two levers brought into contact with any pair of points, the corresponding cell is brought into connection with the testing-lamp and the relative brilliancy of the lamp is a measure of the condition of the cell. In order to prevent short-circuiting of the cells by the use of this switch, the arms thereof are normally kept out of contact with the points by a spring at the rear. By the use of a spring friction-member, shown at the bottom of the switch, it may be set above any pair of points. Pressing the knob will then make the desired connection with the cell selected. The binding posts at the extreme left are for the wires which lead to the audion cabinet.

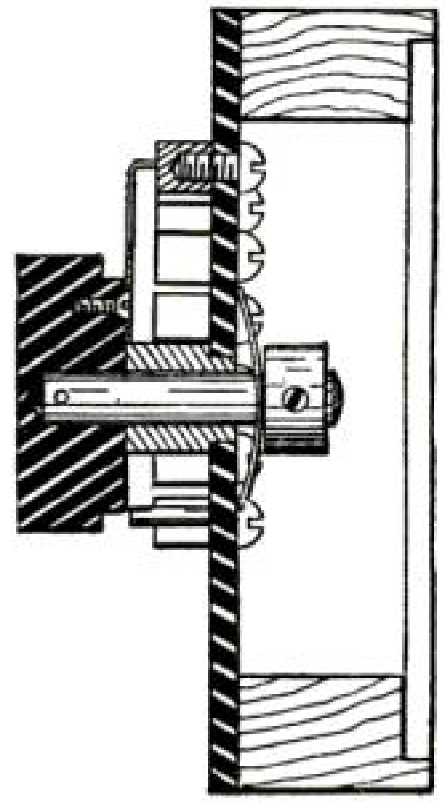


Fig. 6. Section through high-tension switch

An understanding of the interior construction of the case may be gained by an examination of the drawings, Fig. 3 and Fig. 4. Fig. 3 is a view of the case in which the front or switch panel has been removed as well as the top of the case. In Fig. 4 the front

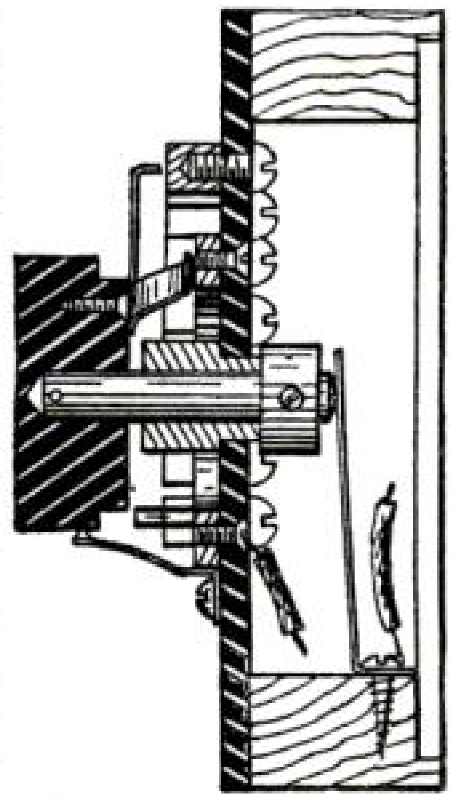
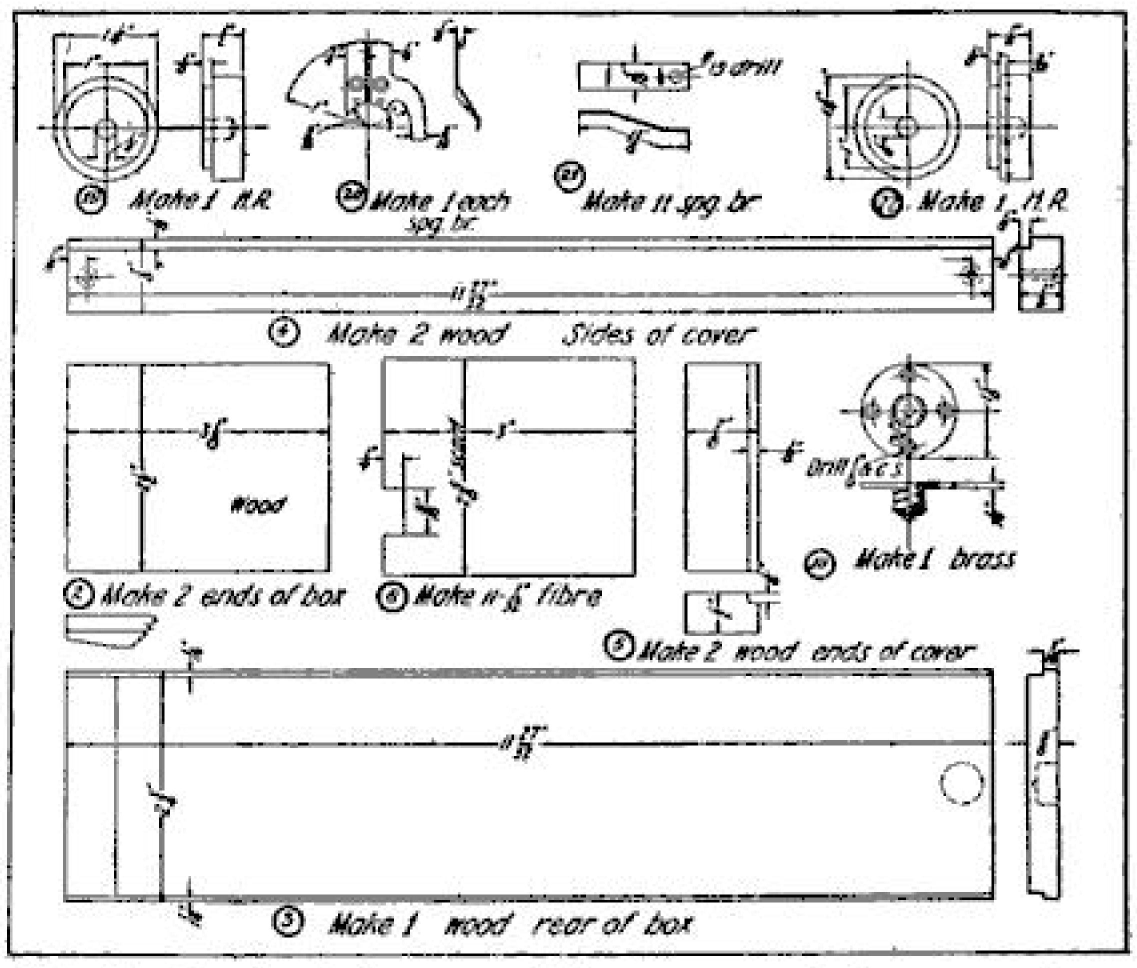


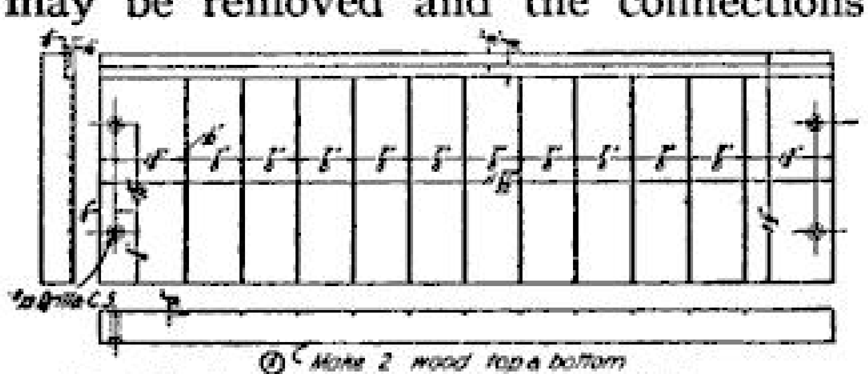
Fig. 7. View through the testing-switch

panel with its wood pieces has been removed and a piece of the second or interior panel broken away to show the arrangement of the cells in the box. It will be seen that the interior of the case is divided into twelve compartments by means of thin fiber strips and at the front of each compartment is a pair of contacts against which the electrodes of the battery are forced by the sliding panel at the back of the case. These two contacts consist of a switch-point and a spring, the switch-point for making contact with the long springlike electrode of the cell and the spring-contact making contact with the short, stiff electrode of the cell.



Details of ends of the case, sliding rear panel, front panel, etc.

By the diagonal arrangement of the spring-contacts shown, the use of connecting wires is obviated and an arrangement made whereby all the cells are inserted in the same position. In Fig. 4 these diagonal springs are shown as suspended in mid-air in order to show the method of making contact. The switch-points further act as connections for the leads to the high-tension switch. Between the front panel and the interior contact panel all the connecting wires are neatly placed and well protected. Fig. 5 is a sectional view taken on the line of the testing-lamp and looking toward the left in Fig. 1. The arrangement of contacts and the connecting space at the back of the switches is here clearly shown. It will be noted that the switch panel with its wood backing forms a cover for the battery holder, and is secured to the latter by means of the large screws shown at the right and left-hand ends of the front panel. On loosening these two screws, the cover may be removed and the connections examined, yet cells may be inserted from the back at any time without disturbing a single connection.



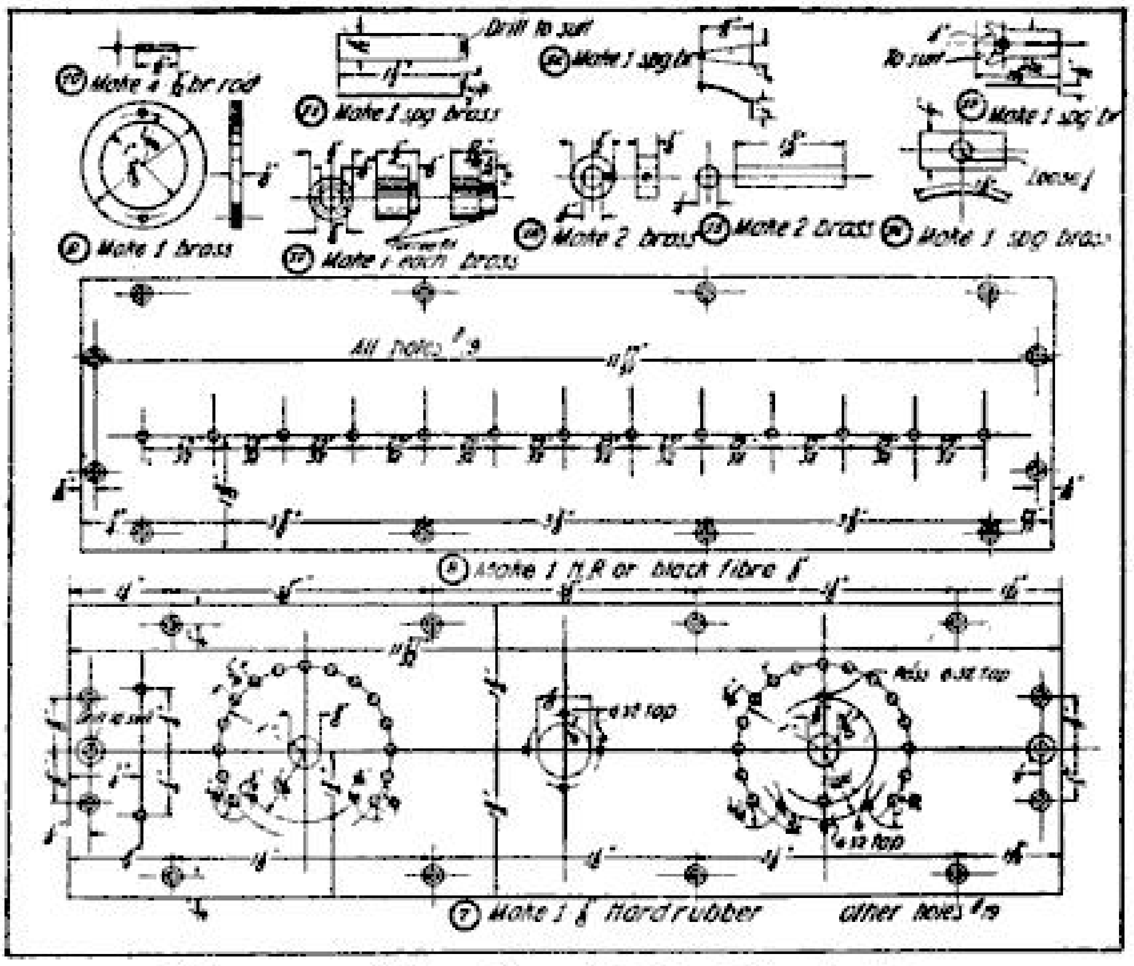
Detail of the top and bottom of the case

Fig. 6 is a section taken through the high-tension switch and shows clearly the arrangement of the switch parts.

Fig. 7 is a section through the testing-switch and shows the arrangement of the parts of this switch and also more clearly how the switch arms are normally out of contact with the points.

Consider now the details of construction in diagrams on this and following page: Detail 1 is at the top and bottom panels of the case. The narrow transverse slots are for the fiber separators and may be carefully cut with a hack-saw. The slot in which the sliding-back of the case fits is shown at the back and should be made smooth and true. Detail 2 shows the ends of the case, and 3 is the sliding-rear of the case. At its right-hand end a recess should be made to enable this piece to be slid out easily. Detail 4 is at the top and bottom of the cover or switch panel support, while 5 shows the end-pieces of the same. The fiber separating pieces (6), should be made a rather tight fit in the slots provided for them.

The front panel (7) should be very carefully laid out before being drilled. It may, after drilling, be rubbed down with pumice stone and water to get the dull finish so much desired.



Diagrams of the other details of the battery

"pin-socket," procured from an electrical supply house, and making a flange as shown. The socket is then soldered into a hole in the flange and filed down neatly, making finally a flush socket.

The hard rubber knob for the high-tension switch is shown at 19, the contact springs for the testing-switch at 20. These springs are cut exactly as shown and bent to suit.

The contacts for the cells (21), should be of very springy material and like the other parts, are preferably nickel-plated in order to prevent corrosion.

Detail 22 is of the hard rubber knob for the testing-switch and is drilled around its periphery to accomodate in the proper positions the friction spring shown in detail 12. It is suggested that the locating holes be not drilled until the switch is assembled, as this insures a much more accurate arrangement of the holes.

Detail 8 represents the interior or contact panel which is best made of fiber.

The contact slip-ring for the testing-switch is shown at 9; 10 shows the stop-pins for both switches.

The spring (11) which keeps the testing-switch contact arms out of contact with the points, is clearly shown in Fig. 7.

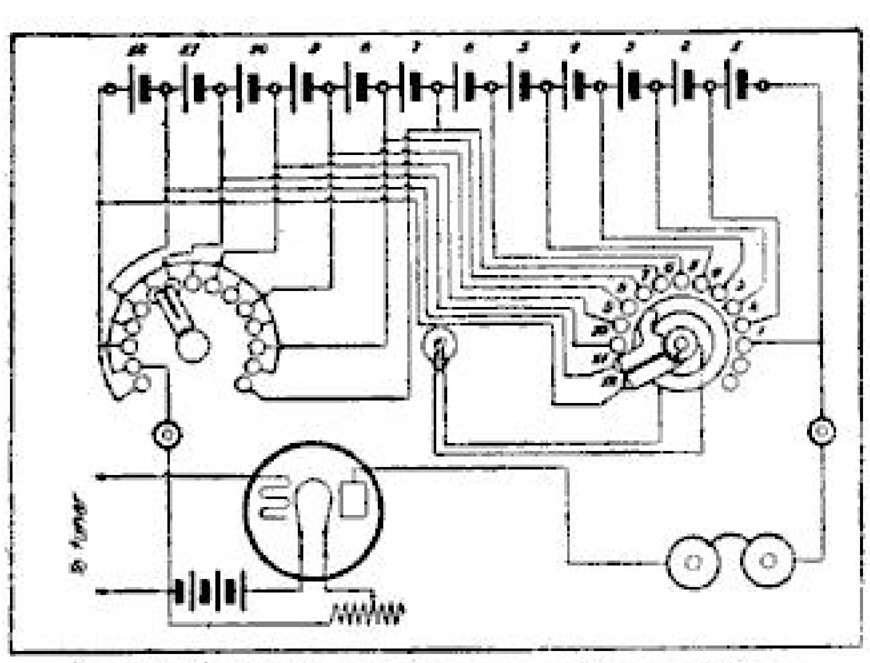
The locating spring (12) for the testing-switch, is also clearly shown in Fig. 7.

Details 13 and 14 are the switch arm and friction spring for the high-tension switch.

Detail 15 shows the centers of both switches, and 16 represents the adjusting collars for them.

The bushings (17) for the switches, should be forced in place in the hard rubber front panel.

Detail 18 is of the socket and flange for the testing-lamp. This is made by taking a



A complete wiring diagram of the battery

In assembling, the battery box is first set up and the fiber panel screwed on after having the contact-springs and points mounted on it. Then the fiber separators are pushed into place. The next step is to assemble the switch panel and mount it on its wood supporting top. The switch-points used are standard ¼ in. by ¼ in. heads having an 8-32 screw-hole at the back. The connecting wires at the back are best soldered into small holes drilled into the screws. The connections to the battery contact points on the fiber panel are also preferably soldered into holes in the end of the screw shanks, these points being the usual type. The batteries used are the No. 603 pocket flashlight cell. The length of the battery box given in the drawings allows ⅞ in. for each cell but it may be best to measure up a set of cells and by dividing the total length covered by the number of cells obtain a fair average.

The points of the testing-switch and cell compartments should be numbered, so that a defective cell may be picked out immediately.

Rejuvenating Electric Lamps

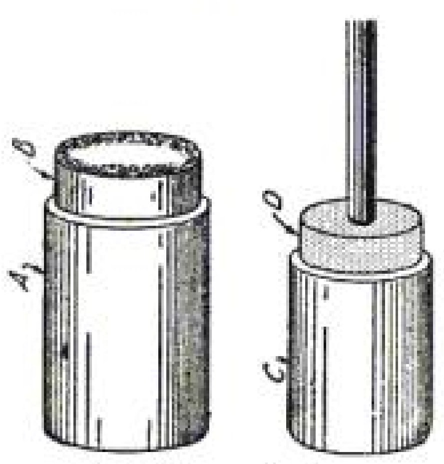
DON'T throw away your burnt-out electric lamps. They can be renewed by this simple method:

File off the tip carefully so that the globe does not crack. With a pair of tweezers, twist the broken filament together. Obtain from the druggist a piece of *yellow* phosphorus for five or ten cents. Insert a piece of it, about half the size of a pea, in the bulb. Cautiously heat the top of the globe by means of a Bunsen burner, and melt a piece of chemical glass over the hole, closing it completely.

The phosphorus unites with the oxygen in the bulb to form phosphorus trioxide, a cloudy substance, which will settle in a few days. The globe is now filled with nitrogen.

The greatest caution must be exercised in the use of the phosphorus. It must be handled under water entirely, and with tweezers. Do not touch it.

An Exciter for Electroscopes

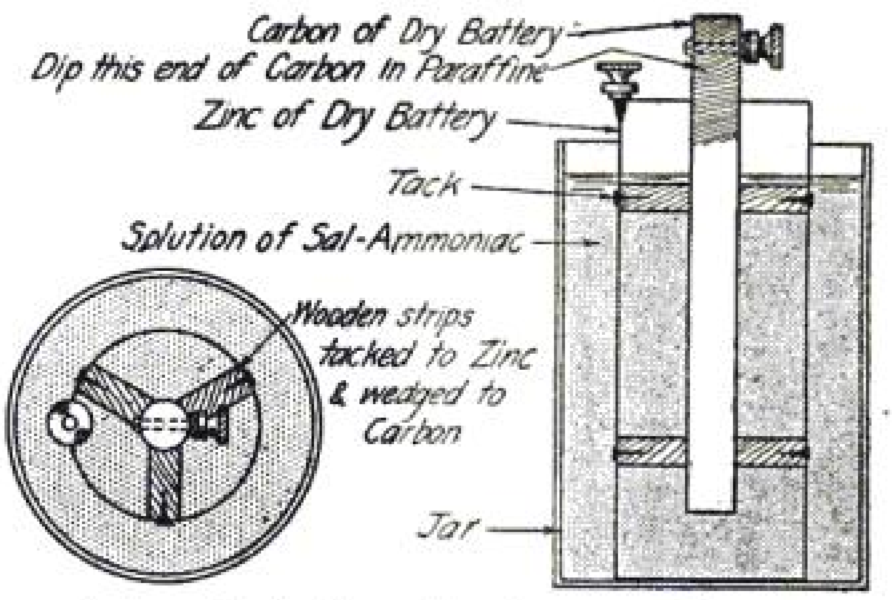


Exciting device

THE electrostatic exciter described in the October number of the POPULAR SCIENCE MONTHLY is rather too powerful for use in charging electroscopes. The following is a handy arrangement involving no risk of damaging the gold leaves.

Find a small glass jar without a neck, and coat with shellac inside and out. Attach a piece of fur inside the jar, the skin side next the glass using the same solution of shellac in alcohol, as an adhesive. Select a small brass tube closed at one end, that will just slip inside the fur, and after fitting in a sound cork, insert a glass rod for a handle. Cover the cork with sealing wax.

Keep the metal tube inside the fur-lined jar when not in use. By merely withdrawing the former it will acquire a negative charge by rubbing against the fur. From the metal tube an electroscope can be charged negatively by contact, or positively by induction.



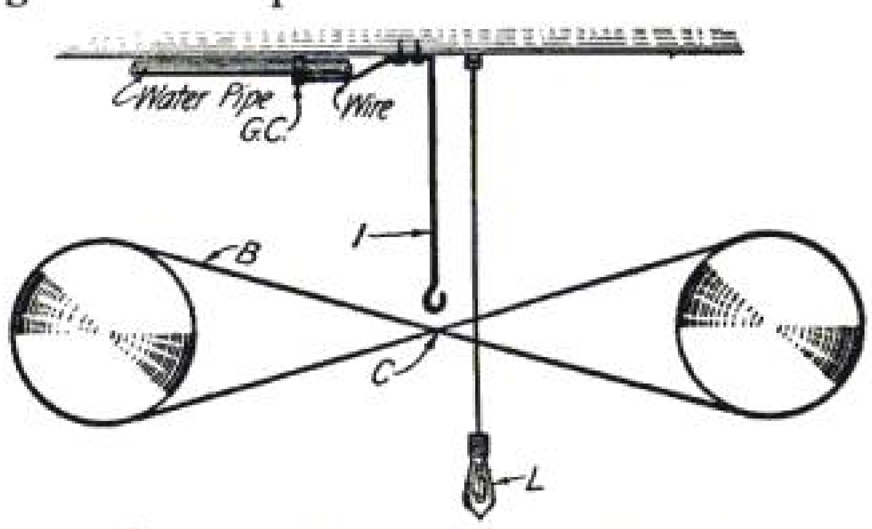
A few minutes' work makes a wet battery from a dry one

A Wet Battery From a Dry One

THE zinc and carbon of an exhausted dry battery may be used to make a wet battery, as shown in the illustration. The carbon should be oven-baked to dry out all impurities. The bottom of the zinc can is removed and a number of wooden strips wedged in, as shown; the carbon should then be tacked in place. The upper end of the carbon is dipped in paraffine, to prevent creeping of the salt. After placing a solution of sal-ammoniac in the can, the zinc and carbon are inserted.—FRANK HARAZIM.

Interference of Lighting Circuit by Static Electricity

THE writer had an electric light that would not last more than an hour without burning out; but during the time that it was in use it gave a very bright light. About nine inches from the lamp cord a belt rubbed at a cross, producing static electricity by means of the friction at the cross. This condition was corrected as shown in the drawing: *L* is the light. *B* is the belt, crossing at *C*; *I* is a piece of iron connected by a copper wire to a water pipe. *G. C.* is a ground clamp.



One more static difficulty overcome

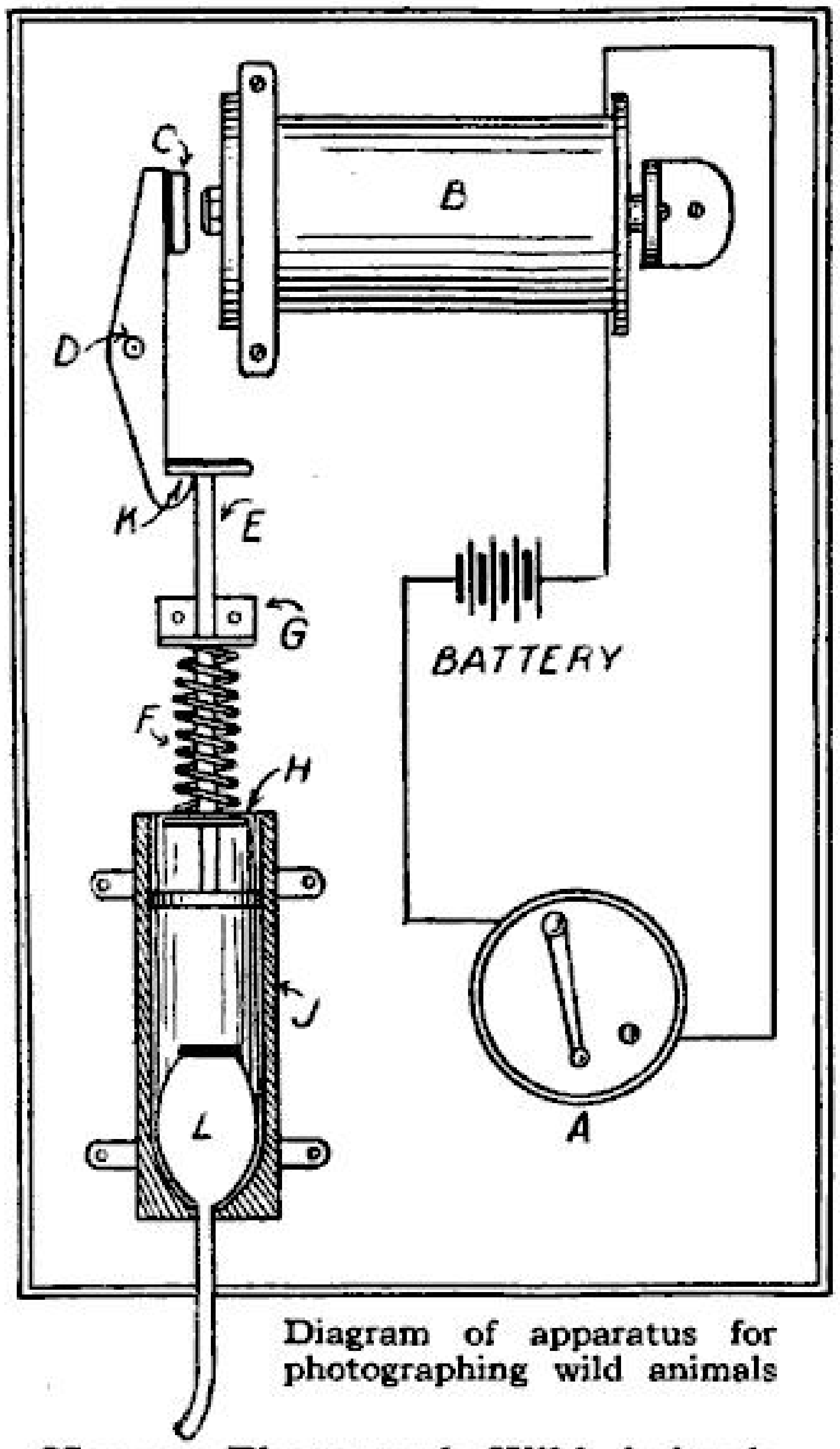


Diagram of apparatus for photographing wild animals

How to Photograph Wild Animals

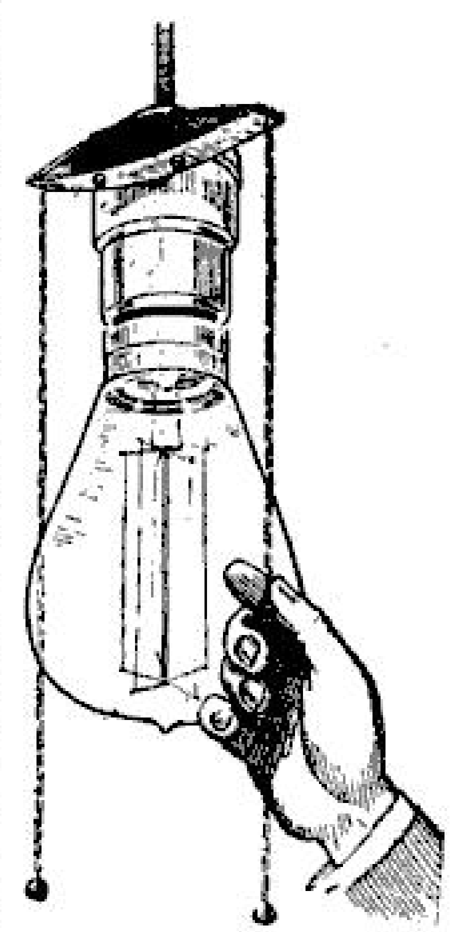
IT will often prove desirable to operate the shutter of a camera at a distance, especially in photographing birds, reptiles or animals in natural poses. The device shown in the accompanying illustration serves the purpose, and its construction and operation are simple.

In brief, the description and operation are as follows: The switch, *A*, or a push-button, is mounted where the operator will not be conspicuous, and is connected, in series, with a magnet *B* and several cells of a battery, by means of a flexible conductor, such as a lamp-cord. The magnet *B* is energized when the switch *A* is closed, and attracts the iron armature *C*, which is mounted on an arm, pivoted at *D*. The lower end of this arm is in the form of a latch, which supports the rod *E* when it is raised to its upper position. The rod *E*, when raised as depicted, compresses the coiled spring *F*, which is held between the gage *G* and the washer *H*, mounted on the rod. A small coiled spring not shown holds the armature *C* away from the core of the magnet *B*. The lower end of the rod *E* is in the form of a piston, which operates in a wooden cylinder *J*. The rubber bulb at the end of the tube leading to the camera shutter is located in the lower end of the wooden cylinder *J*. The device is now complete. As soon as the switch is thrown, the magnet *B* is energized. This moves the latch *K*, and this in turn releases the rod *E*, and the piston at the end of the rod moves downward in the cylinder, on account of the compression of the spring *F*. The piston plunges down on the rubber bulb *L*, causing the shutter to be operated in the camera.

The operator may, of course, be stationed several hundred feet away, and in this case there must be a decided increase in battery power. By means of this outfit, pictures can be secured of shy animals, reptiles, etc., that would never venture out of their hiding places during the presence of a photographer. Many other uses will suggest themselves to the constructor.

Converting a Key-socket Into a Simple Pull-socket

RIVET together the ends of two strips of stiff brass 3 ins. long and ½ in. wide. About 1 in. from both ends punch a hole to receive bolts about ¾ in. long, 3/16 in. in diameter. Place the key of the socket in the center of the strips and tighten up the bolts. Attach strings to the end of the strips. By simply pulling the strings the light can be turned on or off as desired. The materials for this socket can be found in any workshop.—J. M. COHEN.



A pull-socket made from a key-socket

Electric Striking Mechanism for Mission Clocks

MANY of those who possess a mission wall-clock have no doubt wished that it could be made into a "striking clock." This transformation is not difficult with the following materials: a single-stroke electric belt; a small dry battery; an old flat file; 12 pieces of brass for contacts; a small piece of copper for brushes; and several feet of copper wire, screws, staples, etc.

The first thing to do is to make the large contact (Fig. 1). This is made of pieces of an old file. The file should first be annealed, so that it can be cut up into twelve short pieces. An old file should be selected which has a filing surface on the edge; it is the corrugations of this edge that are to be used to interrupt the current for the striking mechanism. The pieces should be just long enough to include twelve notches or corrugations. The corrugated edge of the pieces should be dressed down by filing or grinding, so that on the first piece only the center corrugation is left, on the second, the middle two, on the third, the middle three, etc. The pieces are clamped together with insulating strips between, in the order of their respective number of corrugations—1, 2, 3, 4, 5, etc.

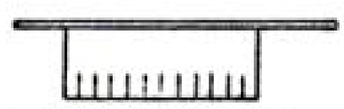


Fig. 2. The brush that is fastened to the under side of the longer or minute hand

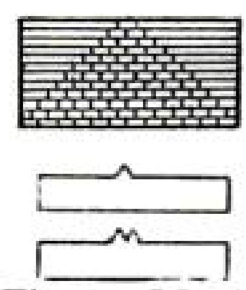


Fig. 1. Making the large contact of pieces of an old file

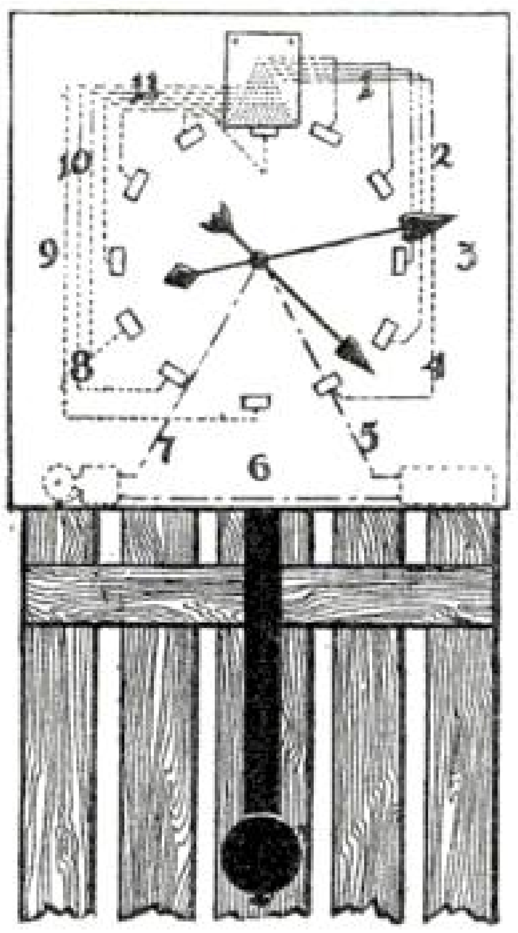


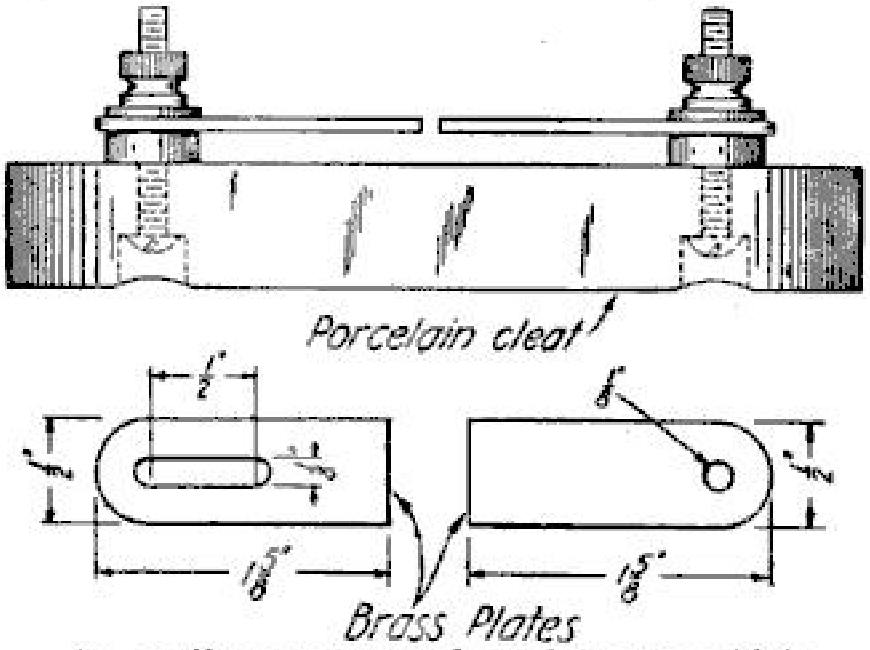
Fig. 3. Contact connections

A Mission clock with an electrical arrangement for striking the hour

If the contacts are to be fastened on the outside of the clock, the hands can be used as contact-arms. The large contact plate should be fastened directly opposite 12 (not necessarily over it) and the small contacts opposite the hours. The hands should then be removed and a brush similar to the one shown in Fig. 2 made and fastened to the under side of the minute-hand. Before replacing the hands one of them should be insulated from the rest of the clock-frame by a small piece of thin silk, wrapped around the stem under the hand. A small brush should be fastened to the under side of the hour-hand to make contact with the small contacts. The brush on the minute-hand should be adjusted, so that each segment of it will come over a row of corrugations. The brush should be nearly perpendicular to the face, as it goes over the large contact, to avoid touching two at a time. The contacts should then be connected, as shown in Fig. 3, by wires run on the back of the face.

In case the contacts are placed on the inside, it will be necessary to make two contact-arms corresponding with the hands. These will be on the inside and will work over the contacts, as the hands did in the other case. In connecting up the contacts it must be remembered that each piece of file (row of contacts) is to be connected with the small contact opposite the corresponding hour. The heavy dash-dot line indicates the main wires; one is connected with the *insulated* hand and the other with the frame of the clock. The bell and battery are connected in series. In fastening the wires small pieces of muslin may be glued over them to hold them in place and to avoid using staples or brads in the clock face.

When the hour hand passes over the contact corresponding with, say, the hour 5, the row containing 5 corrugations is thrown in the circuit, and when the minute hand comes around to 12, its brush passes over the large contact. As the current is only in one piece of the file—i. e., the one corresponding with that hour, all the others are dead. The brush trips from one notch to the next, causing the single-stroke bell to strike five times.—R. L. KENYON.



An easily constructed anchor-gap which may also be used as a plain gap for an ordinary spark-coil

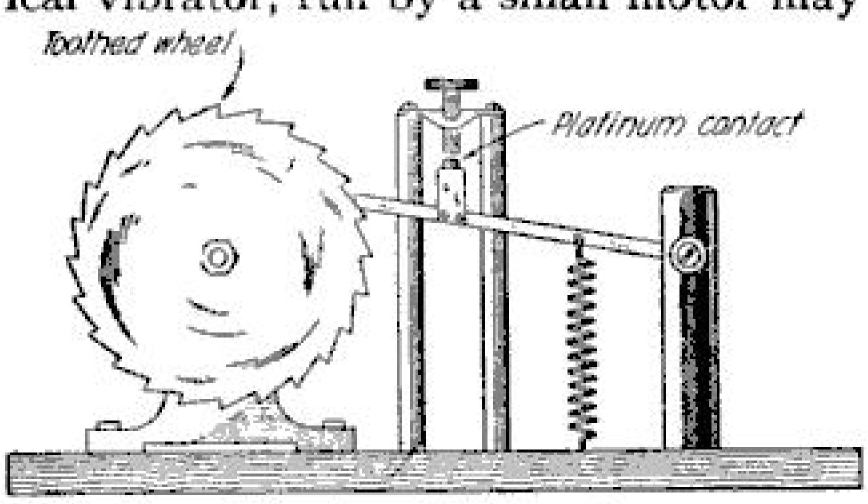
A Simple Anchor-Gap

THE drawing shows a simple and easily constructed anchor-gap.

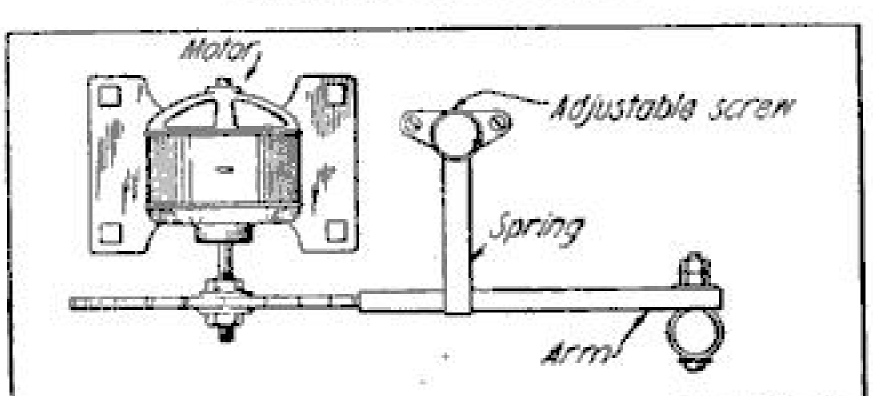
All that is required is a porcelain cleat, about 1 in. by 2 ins. of 1/16 in. sheet brass and two common battery bolts. The holes are afterward sealed with some insulating compound. The slot in one plate facilitates fine adjustment, and this gap may be used to advantage as a plain gap for a small spark-coil, as well as for an anchor-gap.—G. DUNFEE.

Making a Mechanical Interrupter

MANY experimenters have trouble with the vibrators on coils, since very few work satisfactorily. A mechanical vibrator, run by a small motor may



Side view of interrupter



View from above. The vibrator can be made from odd pieces of metal which happen to be at hand

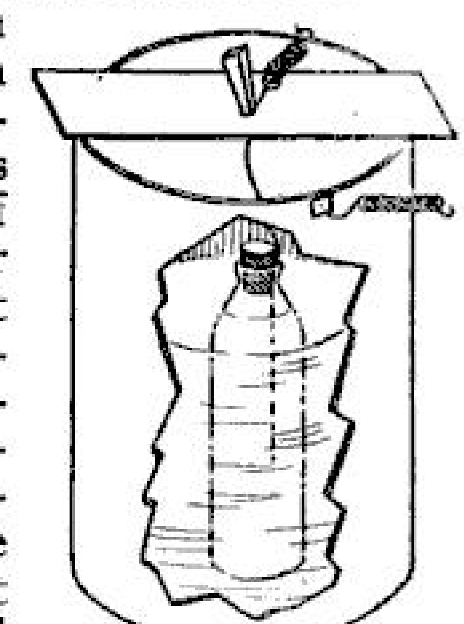
be constructed according to the drawing and will be found to eliminate many of the difficulties. The faster the motor runs, the higher the frequency of interruption.

This vibrator can be constructed from odds and ends, as shown. The toothed wheel should be made of brass, and the teeth cut in with a hacksaw. The vibrative arm is also brass. Soldered to it is a piece of spring steel in which a piece of platinum for one contact is fastened. Two uprights hold the adjusting-screw. The rest of the construction can be seen from the illustration; dimensions are not given, since they may be chosen almost at the will of the experimenter.—H. B. PEARSON.

Temporary Variable Condenser

THERE have been described numerous makeshift variable condensers; but the one here shown is about the simplest, and can be made in a few minutes.

A bottle of thin glass is filled with some good conductive liquid such as mercury. If enough quicksilver cannot be had, salt and water or a solution of sal-ammoniac will answer. An insulated wire with the end bared is thrust deep into the liquid and clamped with the cork; this represents one plate of the condenser. The other plate is a tin can or other vessel partly filled with the same conductive liquid and having a wire clamped on the edge. The bottle is suspended by passing the wire through a hole in a small piece of wood, and plugging it at the height required. Care must be taken that the liquid in the can does not reach the wire extendidg from the bottle.



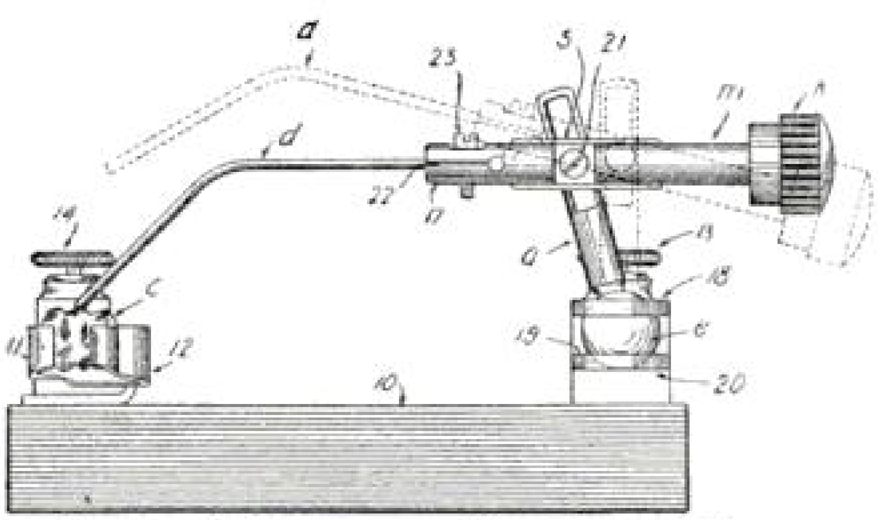
A simple form of variable condenser

Of course with mercury in both and with the outer receptacle made of glass, the best results will be secured. This simple arrangement can be made in a short time, and will be found practical for many simple experiments.

A Delicate Crystal Detector

AN ingenious crystal detector stand which may prove useful has been invented and patented by J. J. Ghegan. The crystal itself *C*, is held in a spring-clip 11, 12, extending from binding post 14 mounted upon the base 10. A cup may be used in place of the spring-clip, when it is desired to mount the crystal permanently.

Contact with the sensitive point of the mineral is made through fine wire or "cat-whisker" *D*, which is fastened in a screw-closed slot 22 in the end of pivoted-rod *M* to which the adjusting knob *K* is attached. The rod *M* turns freely on pivot 21, which is supported near the end of the upright rod *A*. The lower end of *A* is in the form of a ball *E*, which fits closely in the spring-socket



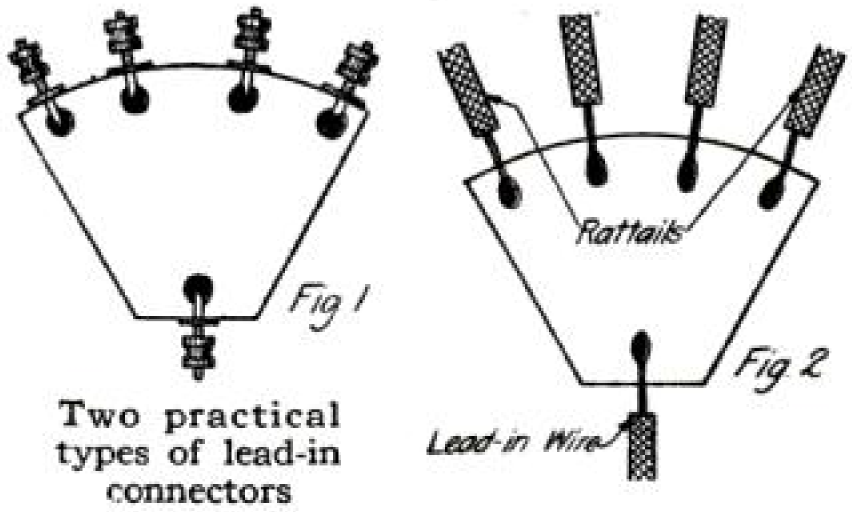
A crystal detector capable of very delicate and varied adjustment

made by pieces 18, 19 and 20.

As can be easily seen, the point of *D* can be moved in any direction by properly actuating knob *K*. The several joints must be made to move smoothly but with enough friction to hold whatever position they may be forced to assume. With this design of holder not only can the point of contact be selected at will, but the contact pressure and the angle of the wire to the crystal surface may be varied widely; all the adjustments are controlled by the thumb and finger through the single knob.

Radio in the Far South

THE two southernmost radio stations in the world are at Tierra del Fuego, the extreme southern end of South America, and on Macquarie Island, South of Tasmania and New Zealand. These stations are about as far below the equator as Sitka, Alaska, is above.



Two practical types of lead-in connectors

A Lead-in Connector

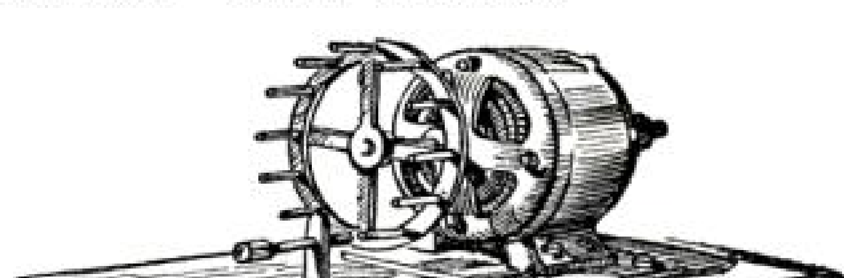
TWO lead-in connectors of simple design are shown in the drawings. That of Fig. 2 is made by soldering binding posts, obtained from the zinc shells of old dry cells, to a piece of sheet metal as shown. Fig. 2 shows one of better electrical design in that all connections are soldered. Both will be found serviceable.—E. R. THOMAS.

An Unusual Code Letter

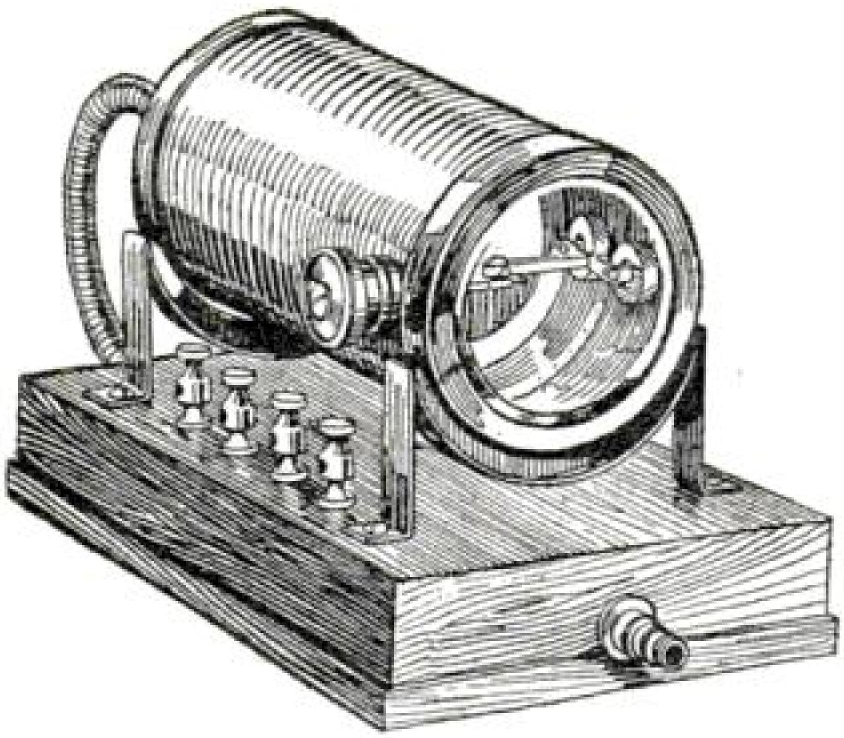
EXPERIMENTERS who listen to messages passing to and from German or Spanish stations are often puzzled by the code-letter of four dashes. This signal represents the combination "CH" and is used as a single letter in the International Morse or Continental code. Four dashes forming one character in American Morse signify the beginning of a new paragraph. Continued practice alone will clear up the confusion on this point.

Mounting a Rotary-Gap

THE noise made by the vibrations of the rotary-gap can be reduced to a minimum by cutting hollow rubber balls in half and placing them under the rotary-gap as shown at *AA* in the illustration. The sound will be greatly reduced.—E. R. THOMAS.



The addition of rubber feet reduces the noise of a rotary-gap to a minimum



A wireless relay for increasing receiving speed and for relaying to telegraph lines

Greater Speed in Wireless Receiving

DR. RAY E. HALL, of Portland, Ore., has recently developed an invention that may increase the speed of wireless receiving by automatically recording at an average speed of a little more than one hundred words a minute. On test that speed has been increased to as much as two hundred words a minute. Speed, however, is not the greatest factor in the invention, which is called a wireless relay, for by means of this device messages may be automatically relayed to a wire telegraph line by the same action which records the message. This may easily open up new possibilities for wireless telegraphy, by connecting it directly to the wire system. The relay may also be used for receiving a number of wireless messages at the same time, on the same aerial at the same wave-length. Relayed messages are automatically written in ink, on commercial ticker-tape. The ability to receive simultaneously several messages is based on tuning to spark-tone or group-frequency instead of to wavelength only.

The relay is connected with the wireless set in place of ordinary telephones. With the device a whole night's work from Sayville, L. I., 1,500 miles away, has been received at the experimental laboratory. The instrument worked alone in a room by itself, since it has attached to it an automatic starting and stopping device. When the wireless message starts, the very first sound transmitted is placed on record, and when the message is ended the tape stops.

A light current of air passing through the box and coil into the cylinder shown in the illustration, is the main element employed in relaying the wireless signal. Any commercial record or sounder, electric bell or light can be attached to the instrument to record the messages.

Receiving Undamped Oscillations

Arrange a piece of fine iron or steel wire, such as that used for the "E" string of a mandolin, over the pole faces of a small horseshoe electromagnet of the kind used in an ordinary buzzer. Mount a contact-screw directly above the wire where it passes across the magnet faces. Connect the magnets in series with an 8 c. p. lamp on the 60 or 120-cycle alternating-current lighting line, and put the iron wire and contact into your receiving-circuit as shown in the diagram.

The arrangement in the accompanying diagram gives a musical note to the signals received from arc or high-frequency alternator stations, the pitch depending upon the number of cycles used in the power line. The vibrating wire much be adjusted so that the contact makes a clean, sharp break each time the lighting current pulls it down. The tuner and detector must be adjusted in the same way as for receiving spark-stations. High-frequency spark-stations can be heard while the wire-interrupter is running, but the notes of their sparks will be changed.

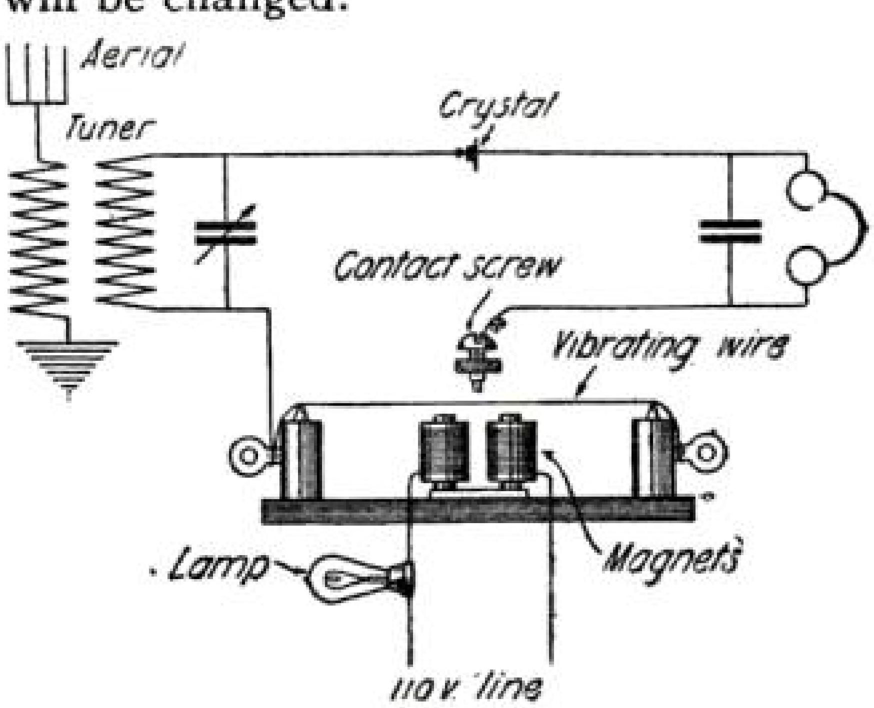


Diagram of a simple receiver for undamped oscillations

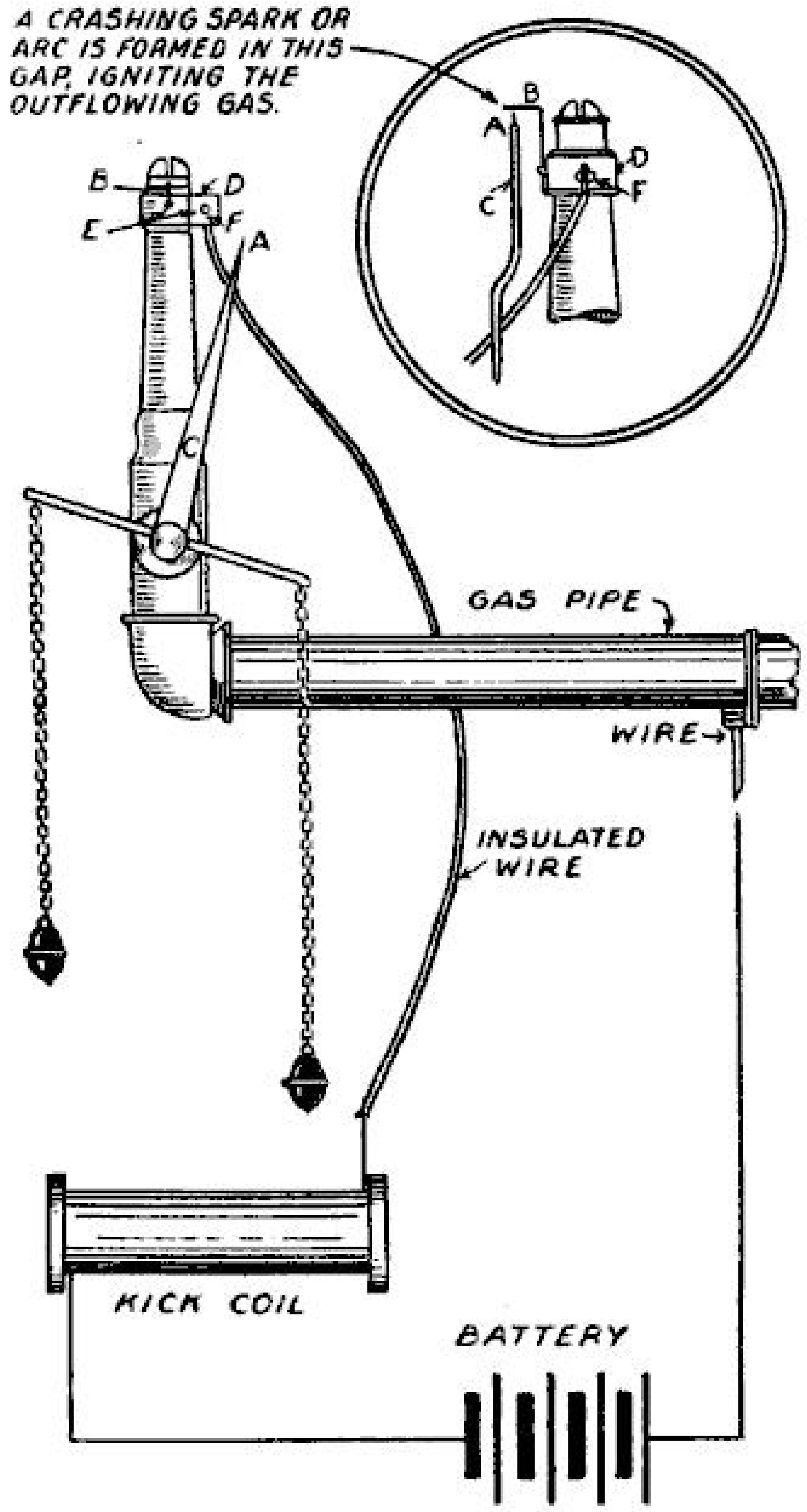
An Electrically Operated Device for Lighting Gas

A SIMPLE and reliable gas-lighting device is shown in the accompanying illustration. The gas is ignited by means of an electric spark, produced between the two parts *A* and *B* of an electric circuit. The circuit is composed of a source of energy, such as a number of dry cells, a kick-coil, the connecting leads, and a special switch, for the opening and closing of the electrical circuit.

The circuit is normally open, but as the lever, controlling the gas valve, is moved or turned from one position to the other, by pulling the chains, the lever *C* is actuated through a certain arc. Now, as this lever *C* moves, its upper end passes the projecting point *B*, which is attached to the upper portion of the burner, and the electric circuit is completed and broken. Just as the point *A* leaves contact with the point *B*, an arc is produced. This electric arc is greatly intensified by the electric kick-coil. The two points *A* and *B* should be made of platinum, since any other metal will not withstand the extremely high temperature of the arc produced.

Pieces of platinum may be obtained from an old incandescent lamp. The contact piece *B* is mounted on the brass collar *D*, by means of a small screw *E*. The collar *D* is held in place by the screw *F*, which draws the two ends firmly together. This collar must be insulated from the fixture or stem by some thin sheets of mica, to prevent a short-circuit. The upper piece of platinum *B*, should extend just high enough to reach the lower edge of the gas flame.

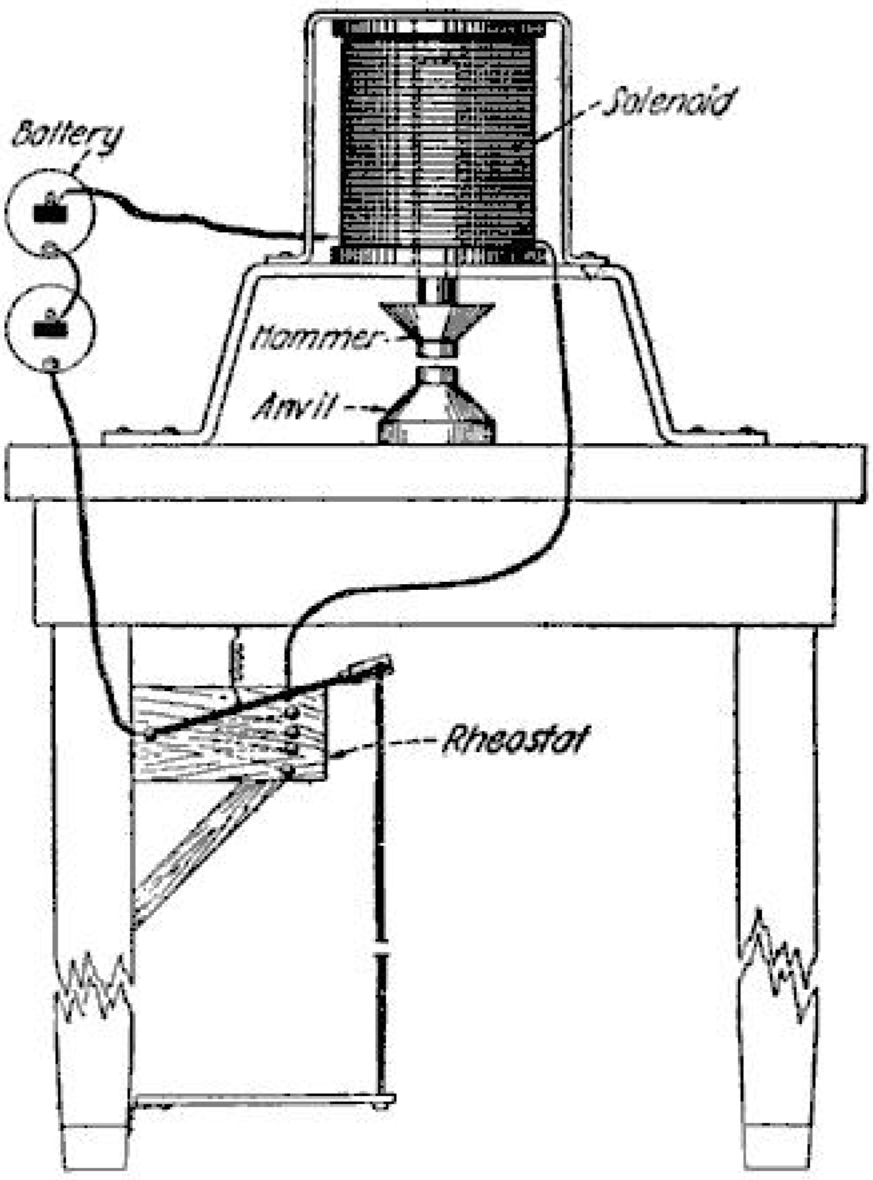
Now mount an arm *C* on the valve stem so that it stands in a vertical position when the lever to which the chains are attached is in a horizontal position. Bend this arm into the form shown in the figure, and cut its upper end off so that it is about ½ in. below the outwardly projecting end of the piece of platinum *B*. Drill a small hole in the upper end of *C* and, after inserting a piece of platinum, apply some solder. Then the complete burner and the valve are mounted on the gas fixture, and from the collar *D* an insulated wire is carried to the point where the battery and the electric kick-coil are located. The gas fixture itself forms one side of the circuit, and therefore one terminal of the battery should be connected to the gaspipe, as depicted.



By slowly pulling the left-hand chain, the gas can be electrically lighted

An electric kick-coil, like the one here used, may be purchased in any electrical establishment, or one may be made by cutting up some iron wire or stove wire and fastening the lengths in a snug bundle, gluing and covering this pack of wire with good stiff writing paper. Then six layers of cotton-covered No. 18 gage wire are wound neatly and evenly on top, and of course, each and every layer is insulated from the preceding one by several thicknesses of paper.

At least four dry cells will be required if satisfactory results are desired. Bear in mind that the gas must be escaping from the burner when the arc is formed.



A treadle is used for operating the rheostat of this electrical hammer

A Model Electrical Hammer

AN electrical hammer is simple and practical in construction and, if built to a fair size, may be utilized in doing small and light riveting work, such as jewelers and model makers encounter. A solenoid or suction-type electromagnet forms the basis of the apparatus. The magnet may be about 3 ins. in length, with end disks about 1¾ ins. in diameter, and a brass or fiber tube of ½-in. inside diameter running through its center.

If a metal tube is used, it should be properly insulated by several layers of paper. The coil is formed of No. 16 enameled or cotton-covered wire, wound in even layers and filling the bobbin. The two leads are put into the circuit as shown, with the foot-operated controller or rheostat.

A rheostat is fastened at a convenient level; and a string is attached to a small hook on the end of the rheostat handle and connected with a hinged pedal. A stiff brass spring is stretched between the handle and a point on the rheostat board so that the current is immediately disconnected as the foot is withdrawn.

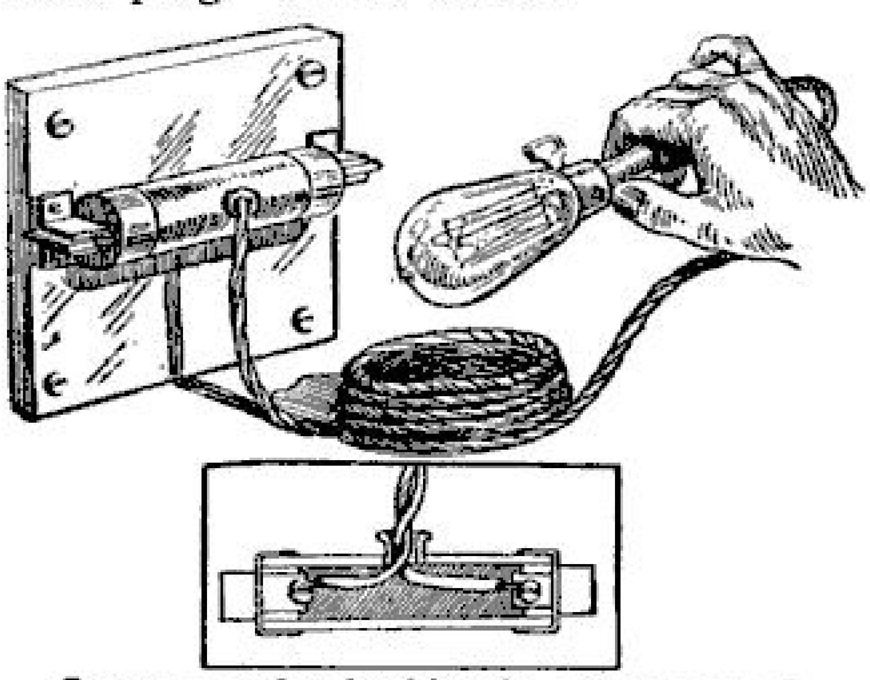
A small anvil-iron is attached at the bottom of the point where the iron hammer or plunger drops down. On the lower point, the switch or rheostat breaks the solenoid circuit, allowing the hammer to drop heavily on the anvil or object to be riveted. On the top point the coil receives its greatest power from a battery of from 4 to 6 dry cells, which eventually sucks back or withdraws the plunger into the hollow tube in the solenoid magnet. If the foot is lifted up and down, or the handle of the rheostat operated by hand, the hammer will move up and down forcefully.

Compact Condensers

WHEN mica is used to separate the plates of condensers, the capacity is nearly seven times as great as though the dielectric were simply air. For a given thickness, the voltage may be made about three times that which glass will withstand. Mica is light in weight also, and because of these three features it is being used more and more in radio transmitters.

How to Make an Attachment-Plug

TO make an attachment-plug of an old fuse-plug, first make a hole in the center of the mica cover, so that a socket-bushing will screw in tightly. Take the cover off by prying around the edge of the brass ring. Seal the socket-bushing on the inside by heating and shaping it like the outside, then bring the lamp end through the bushing, solder the wires to the cap and screw-contacts, put the cover on, press back the rim in place, and you have an attachment plug.—H. L. BAER.



Insert a socket-bushing in a fuse-plug to form an attachment-plug

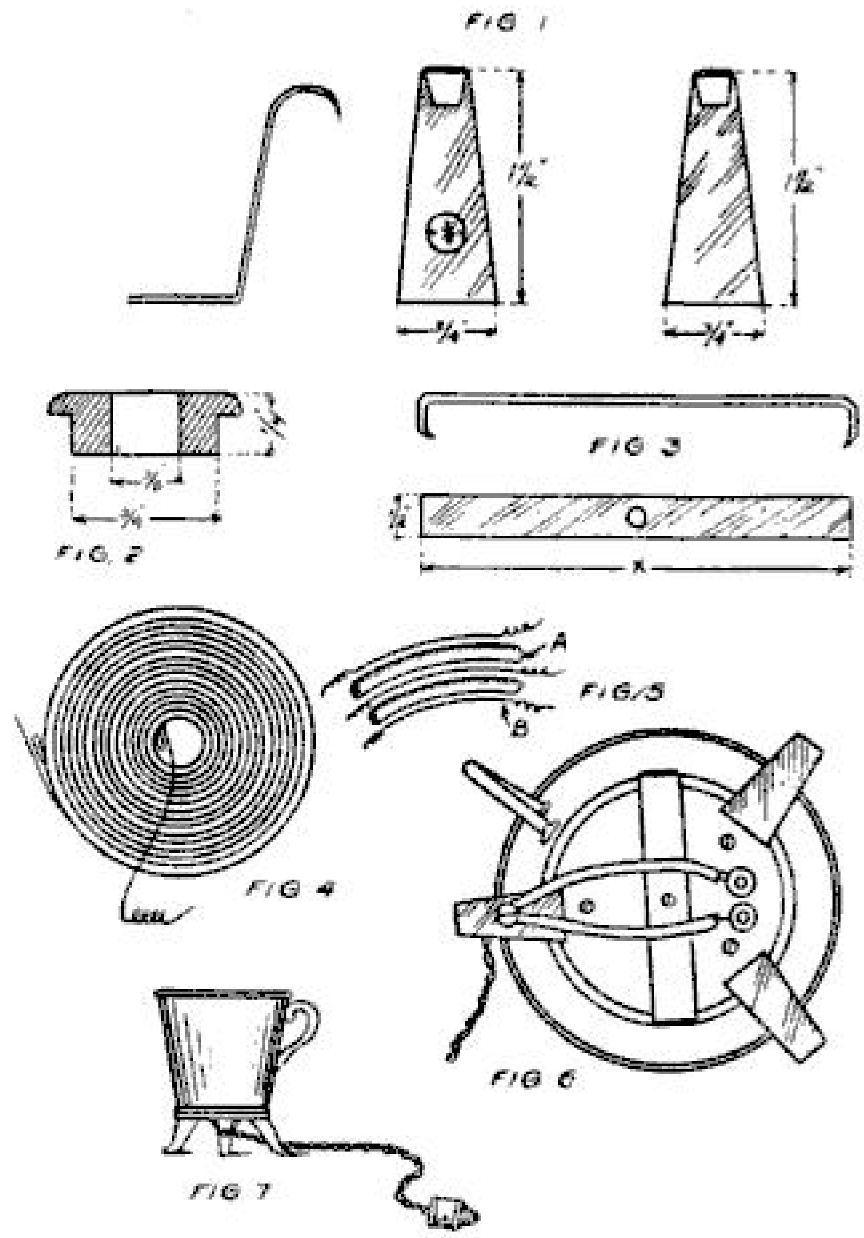
How to Make an Electric Shaving-Mug

THE general use of electricity in the home has opened up a new field in the way of cooking and heating utensils. Such appliances are usually supplied by electrical houses, but many of the utensils may be easily and neatly constructed at home. One of these is the electric shaving-mug. A mug or cup, capable of standing heat, is the first thing required. An aluminum cup of standard shape and design, which may be purchased in any town, will do perfectly well.

These cups are spun from a flat sheet, and have no seams to open or leak. It is also necessary that no holes be drilled in the mug, since it will be utterly impossible to make such holes watertight again. The heating element must be fastened to the mug with a clamp. This clamp will also allow the heating-coil to be removed for repairs, and makes it easily accessible at all times. The bottom of such a mug commonly has a flange, which makes a recessed part, and in this the heating-element is placed. The legs of the mug are to be made of sheet brass, as shown in Fig. 1, one of the three having a hole near the center for an insulating button (Fig. 2), of "transite" or some other material to hold the supply cord in place. The clamp, for holding the heating-coil, is shown in Fig. 3. This clamp has a screw in the center to tighten it in place.

The heating-coil or element is depicted in Fig. 4, which is a coil of flat "nichrome" wire, or ribbon, as it is called, 12 ft. long, 1/16 in. wide, and 3/1000 in. thick. This is equal, in cross-section, to a No. 26 gage wire. To wind this coil, procure a block of wood, 7/8-in. thick, about 4 ins. sq., with a 1/2-in. hole in the center for an axis or pivot. Clamp a 1/2-in. rod in a vise so that the block can be rotated around it. Beginning at the center, fasten one end of the nichrome ribbon to the block, leaving about 2 ins. surplus to make a connection. Then proceed to wind the ribbon in a spiral coil, separating each turn from the preceding one by a strand of asbestos cord.

A small section of this coil, as it would appear highly magnified, is depicted in

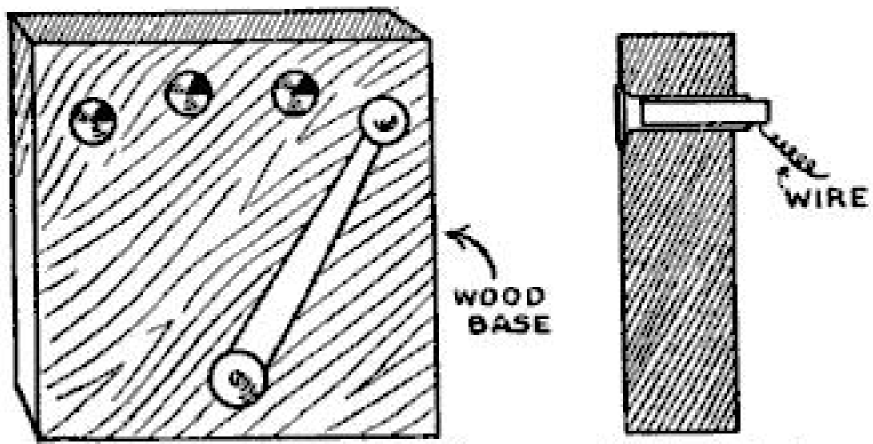


Details of the shaving-cup and construction of the heating-coil

Fig. 5, where *A*, or the lightly shaded part, represents the asbestos insulation, and *B*, or the black lines, the ribbon. This asbestos insulates each turn of the coil from the next nearest, and the electrical current must travel entirely through the resistant element, instead of jumping from one turn directly to another, which would be the case, if insulation were not used. The coil must be very closely wound, in order to get it into the very limited space in the bottom of the mug.

Before taking the coil from the block, rub into its surface a little asbestos retort cement, or a cement composed of a mixture of silicate of soda and silica, or glass sand. This mixture, when dry, will tend to hold the coil together, and the current may be passed through the coil, to test it, as well as to bake it in its coiled shape. The support for the coil is a disk made from a piece of 5/16-in. asbestos, wood or transite. Cut it to fit into the recessed part in the bottom of the mug. Then with a chisel, remove enough material from the top of this disk to form a depression, 1/16

in. deep, to receive the coil flush with its top. The leads of the coil are run through the disk. The surface of the coil is then plastered evenly with retort cement. The legs are fastened to a second piece of insulating material with round-headed brass machine-screws, ½ in. long, with nuts. See Fig. 6.



Cartridge shells make neat electrical contacts for a rheostat

Using Cartridge Shells for Electrical Contacts

A NOVEL use for cartridge shells of the old center-fire kind, certain to interest the electrical experimenter, is in making rheostats, small switchboards and important contacts on wireless apparatus, where efficiency is considered. A hole a trifle smaller than the diameter of the shell is made in the base and the cartridge shell forced into the hole made, as shown in the diagram.

The proper wires are then soldered to the metal on the inside, or the wire may be placed inside of the shell and held securely in position by driving a wooden plug into the empty shell, as depicted. A complete rheostat may be so made. The heads of the shells offer efficient contacts.

The Best Crystal Detectors

IN spite of the fact that crystal detectors play so important a part in the experimentation of electrical amateurs, their use is not understood as well as it should be. There are various combinations in use. It will be found, in general, that the more sensitive a crystal is, the more readily will it lose its adjustment or "knock out" from loud signals or static. The average amateur will get more satisfaction from using a single crystal than from a combination. For example, although perikon has many desirable characteristics, there is apt to be trouble from particles of one of the crystals rubbing off, and adhering to the surface of the other. This is constantly occurring.

Chalcopyrite and zincite, arsenic and silicon, and antimony and silicon are all used in combination, and are remarkably sensitive. An occasional wash with carbon disulphide helps to remove grease and dirt from the surfaces, and often restores them to sensitiveness.

Carborundum is proof against all manner of knockouts, but is unfortunately not very sensitive. A stiff wire or needle makes the best contact with this substance, and should be pressed down into it with considerable force. A battery must be used with this detector.

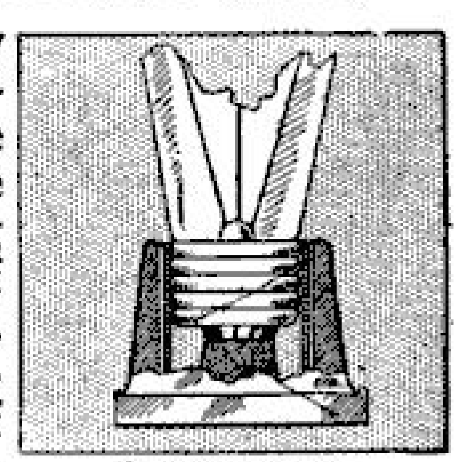
Silicon is more sensitive than carborundum, and is correspondingly more easily knocked out by static. A light contact is required, and the efficiency is often improved by applying an exceedingly small potential.

Galena is probably the most sensitive of the crystal detectors, but is hard to keep in adjustment. It is especially sensitive to static. The wire used should be as fine as possible. Certain violin and mandolin strings are wound with very fine silver wire; this wrapping is most suitable for use with galena.

A minute fraction may be cut off the end of the wire from time to time, thus always insuring a clean point. Cerusite requires about the same treatment as galena. Iron pyrite works best with a firm contact, and is almost as sensitive as silicon.

Testing Electric Lamps Quickly

WHERE many incandescent lamps are tested, much time is lost in screwing them in and out of the testing-socket. This can be remedied by means of an ordinary porcelain lamp-socket.



A test-socket

Remove the inner shell and hammer its threads down on a ⅝-in. pipe. The diameter should then be great enough to admit the threaded base of the lamp. After replacing the shell, lamps can be readily tested by merely sliding them into this socket.

What Radio Readers Want to Know

When Is the Transmitter in Good Condition?

Ricardo Moran Pereira, Guayaquil, Ecuador, S. A.:

The information you request concerning the operation of wireless telegraph equipment is mainly covered in the various textbooks of wireless telegraphy, but not specifically taken up in any particular one. The necessary tests for determining the condition of radio telegraphic apparatus are so well understood by those engaged in the work that the authors have neglected to take up this phase of the subject.

The condition of the secondary winding of a high potential transformer may be tested in the following manner: Connect a small spark-gap in shunt to the secondary winding and supply the primary winding with correct value of potential. If a good fat spark discharge is not secured at the secondary terminals even when the gap is of excessively short length it is an indication that all or a portion of the secondary winding is short-circuited.

The open circuit in the primary winding of a transformer may be determined by connecting a 16-candlepower incandescent Edison lamp in series with the circuit. If the lamp does not glow it indicates that the circuit is open. If the primary winding is short-circuited the fuses will blow whenever the circuit is closed.

A breakdown of the high potential condenser is generally directly visible.

Violent brush discharge at the condenser is an indication of excessive voltage or a spark-gap of too great length. It is also sometimes due to the irregularities in the coatings which may have jagged edges. To some extent brush discharge can be prevented by immersing the condensers in oil or by the use of a series-parallel connection, thereby dividing the potential between several banks.

Regarding the matter of induced potentials from the aerial system, in any radio installation every effort should be made to keep the low potential power wires at a distance from the high-frequency circuits. In any event the low potential power mains should be placed in the iron conduit, the latter being directly connected with the earth.

The condenser is prevented from discharging into the secondary winding by means of high-frequency choke-coils which generally consist of four to ten turns of copper wire wound in the form of a pancake spiral with the turns spread about $\frac{3}{4}$ in. The inductance of these coils has little effect upon the potential of the secondary winding but offers a very high impedance to the high-frequency currents of the condenser.

The dimensions of the condenser are limited by the wavelength to be employed. In the case of a 1 k.w. set operated from a source of 60 cycles, it is customary to use a condenser having capacity of .012 microfarads; 2 k.w. sets employ capacities varying from .018 microfarads to .036 microfarads.

To go into these matters more in detail would require the space of a small textbook, and we believe that your queries taken as a unit are best answered in a publication entitled "Textbook of Wireless Telegraphy" by Rupert Stanley. This book is probably the most up-to-date one on the subject, as it gives the theoretical principles and the practical details of modern commercial telegraph apparatus.

Receiving 3,000 Miles

I. E. R., Cuenca, Ecuador, writes:

Q. 1. Can you give the dimensions and the best type of an aerial for the reception of signals to a distance of 3,000 miles? This aerial is to be used with the Navy type of loose-coupler.

A. 1. If this aerial is to be employed for wavelengths up to 3,000 meters from stations using damped oscillations, the flat top portion of the aerial may consist of four wires spaced $2\frac{1}{2}$ ft. apart, 350 ft. in length, and from 120 to 200 ft. in height.

Q. 2. What is the least expensive detector that could be used for the purpose?

A. 2. Any of the detector minerals such as galena, cerusite, molybdenite, silicon and carborundum are inexpensive. The audion is the most sensitive detector in existence, but of course is more expensive than any of the foregoing.

Flickering of Lights

E. B., Centralia, Ill., inquires:

Q. Why should a $\frac{1}{2}$ k.w. transformer make the lights flicker, and what can be done to remedy this?

A. When the condenser connected in shunt to the secondary winding of the transformer discharges across the spark-gap, the secondary winding is temporarily short-circuited, and unless the magnetic circuit of the transformer is arranged to have a certain amount of magnetic leakage, the primary winding will draw an excessive value of current. You may perhaps be able to lessen this effect by changing the capacity of the condenser or by inserting a reactance coil in series with the primary winding. It is also possible to connect a reactance coil in shunt to the telegraph key. When connected in this manner a portion of the energy constantly flows into the primary winding, and the remainder or the full intake flows when the key is depressed. This method has often been found to assist matters materially.

Windings for Receiving-Tuner

P. K., Somerville, Mass., inquires:

Q. 1. Will a loose coupler having oval tubes for the primary and secondary winding be as efficient as one using round tubes?

A. 1. Yes, practically so.

Q. 2. Which is preferable for the windings, cotton or enameled copper wire?

A. 2. Cotton wire is generally preferred to enameled wire, but it is the general practice in commercial apparatus to use single silk-covered wire.

Q. 3. Are No. 22 B & S and No. 32 B & S wire correct for the primary and secondary of an inductively-coupled receiving-tuner?

A. 3. Yes, but generally No. 24 or No. 26 is used for the primary winding.

Detailed Dimensions of a 3,000-Meter Tuner

G. O. B., Kimbolton, Ohio, inquires:

Q. 1. Please give explicit instructions for the construction of an inductively-coupled receiving-tuner for all-around amateur work, taking particular care to state the number of turns necessary for the primary and secondary windings, also the number of taps to be taken from these windings.

A. 1. For all-around amateur work, the receiving-tuner should be responsive to wavelengths inclusive of 3,000 meters. The primary winding should be 5½ ins. in length by 5 ins. in diameter, wound closely with about 300 turns of No. 26 wire. The secondary winding should be 5 ins. in length, 3½ ins. in diameter, wound closely with 500 turns of No. 32 wire. The inductance of the primary circuit may be altered by means of a multipoint switch or by a sliding-contact. It is customary to fit this winding with two switches in some tuners. For example: The first ten individual turns of the winding may be connected to a ten-point switch; the remaining turns are connected in groups of 10 to the contact-points of a second switch. In this instance you require a 29-point switch for the groups of ten turns. The turns of the secondary winding may be equally divided between the taps of a ten-point switch. This secondary winding should be shunted by a variable condenser of a small capacity, say .001 microfarads, for tuning.

Small Power-Transmitter

G. W., Elk City, Okla., inquires:

Q. 1. Will a spark-coil from an automobile have sufficient power to act as a wireless transmitter for a distance of two or three miles?

A. 1. Yes, provided the potential is sufficient to jump a gap of at least ¼ in.

Q. 2. Will telephone induction-coils serve the same purpose?

A. 2. Generally, no. If the potential of the secondary of the coil is sufficient to give a small spark-discharge, it may be used for extremely short distance work, but not otherwise.

Q. 3. Will a steel tower interfere with the reception of messages if the aerial is attached to it?

A. 3. No, not if the wires are swung out at a distance from the tower.

Receiving Aerial

W. L., Secaucus, N. J., writes:

Q. 1. Please advise if an aerial of four wires 20 ft. in length by 20 ft. in height has sufficient dimensions to receive wireless telephone messages with an ordinary telephone receiver and a crystalline detector.

A. 1. To begin with there are no wireless telephone transmitting stations in operation from which you could receive signals. The experiments at the Naval Station at Arlington to which you probably refer were conducted on a wavelength of 6,000 meters. Your aerial is entirely too small for adjustment to long waves. A single wire from 500 to 800 ft. in length could easily be loaded to a fundamental wavelength of 6,000 meters.

Long Wave Receiving Tuner

P. A. J., Jr., Suffolk, Va., writes:

Q. 1. I propose to wind the coils for a receiving tuner on two tubes; one is 11 ins. in length by 6 ins. in diameter and the second 12 ins. in length by 5 ins. in diameter. What size wire should I use and to what range of wavelength will it be adjustable?

A. 1. Use the 11-in. tube for the primary winding and cover it with No. 24 S.S.C. wire. Connected to the average amateur aerial, it will permit adjustments inclusive of 6,000 meters. 750 feet of wire are required for this winding.

The secondary winding requires approximately 1,250 feet of No. 30 S.S.C. wire. Connected in shunt to a small variable condenser, it will respond to wave lengths between 8,000 and 9,000 meters.

Licensing of Sending Stations

R. D. S., Ripley, Okla., inquires:

Q. 1. With a transmitting set composed of a ½-in. spark-coil, small oscillation transformer and glass plate condenser, would I require a U. S. license if my station is located 65 miles from the State Line and 15 miles from the nearest radio station which is a college experimental station located at Stillwater? If a license is required please give the necessary instructions for obtaining it.

A. 1. During the daylight hours the range of this apparatus will not exceed 20 miles and in consequence a license is not required. It is equally probable that the signals from this station will not extend over the State Line during the night hours.

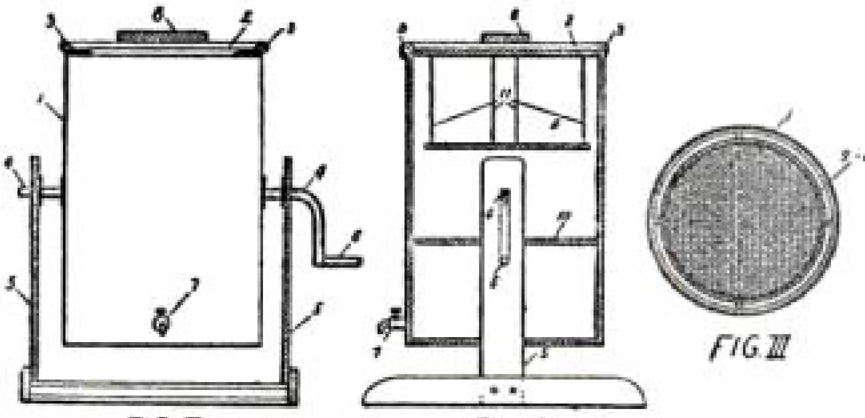
The Home Workbench

Making a Washing-Machine From a Barrel

A VERY serviceable washing-machine can be made from an old barrel-churn whose capacity is from fifteen to twenty-five gallons. First construct, of heavy galvanized-iron, a cylinder about 30 ins. long and of the same diameter as the head of the churn. One end of this cylinder should be left open and the head of the churn, with its locking-device, fastened to the open end. Find the balancing-point of the cylinder with the head on. Fasten the churn bearings on with rivets and solder to make a water-tight joint.

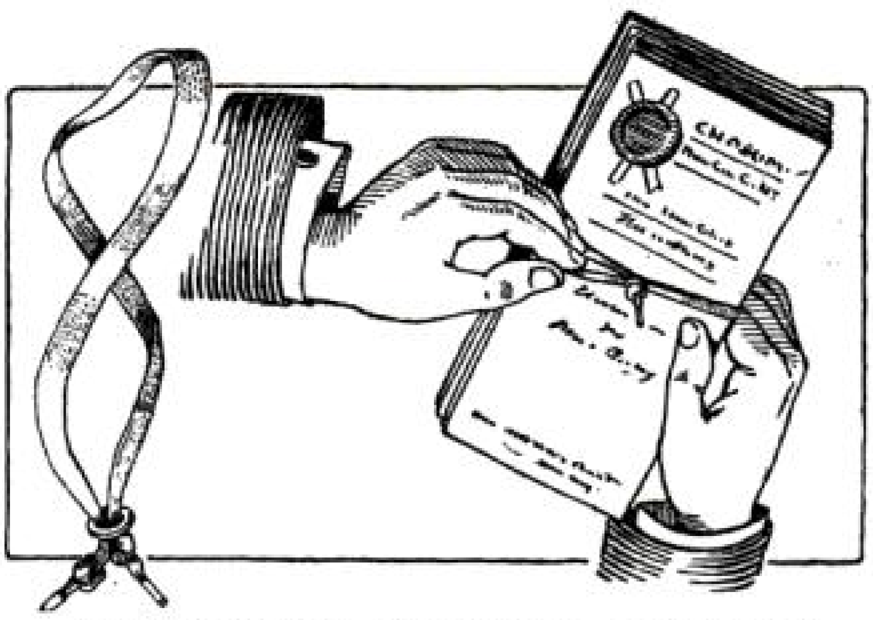
Make two screens of galvanized wire, with about 1-in. mesh. One of these is suspended from the movable head by ¼-in. galvanized-iron rods, and the other is fastened in the cylinder, so that they are about 10 ins. apart and occupy the middle part of the cylinder.

In the diagrams 1 represents the cylinder; 2, the movable head; 3, the brackets which hold it; 4, the bearings; 5, the frame supports; 6, the handle; 7, a small drain-cock; 8, the locking device for the head; 9 and 10, the screens, and 11, the rods that support the top one.



By fitting two galvanized-iron wire screens in a barrel-churn, a serviceable washing-machine can be made

The action is, of course, the same as that of the churn, the clothes being confined between the screens; the water, surging back and forth thoroughly cleans them.—J. FRANK DWIGGINS.



The simplicity of this tape is its chief merit. When drawn up taut, a tiny ring holds it securely in place

A Package Tie Made of Tape

RECOGNIZING that the string is best for tying a package of papers, it only remained for some one to work out a method of making a holding device that would not require making a knot and have something that would hold the papers tightly, yet be of such character that it could be quickly released.

This tie has been accomplished by a small ring placed on a piece of tape, the tape having knots in the ends to prevent the ring coming off. It is only necessary to slip the looped end of the tape over the package and pull on one end of the tape. To release the holding grip, pull on the other end of the tape. The tapes are made up in various lengths to suit the packages. This invention will add to the efficiency of any office, at small expense.

Making a Lawn Chair

THE accompanying drawing shows a chair for use on the lawn. The materials required are hardwood strips 7/8 in. by 2 1/2 ins.; one 3/8 in. round iron or steel-rod threaded on each end with two nuts; two 3/8-in. bolts, 2 1/4 ins. long under the head; two 3/8-in. bolts 2 3/4 ins. long with two nuts each; two 3/4-in. or 7/8-in. dowels, 2 1/2 ins. long; one strip of awning stripe duck, or stair crash, 20 ins. wide, one piece of 1/2-in. pipe, some 3/8-in. washers, and from twelve to sixteen ounces of upholsterer's tacks.

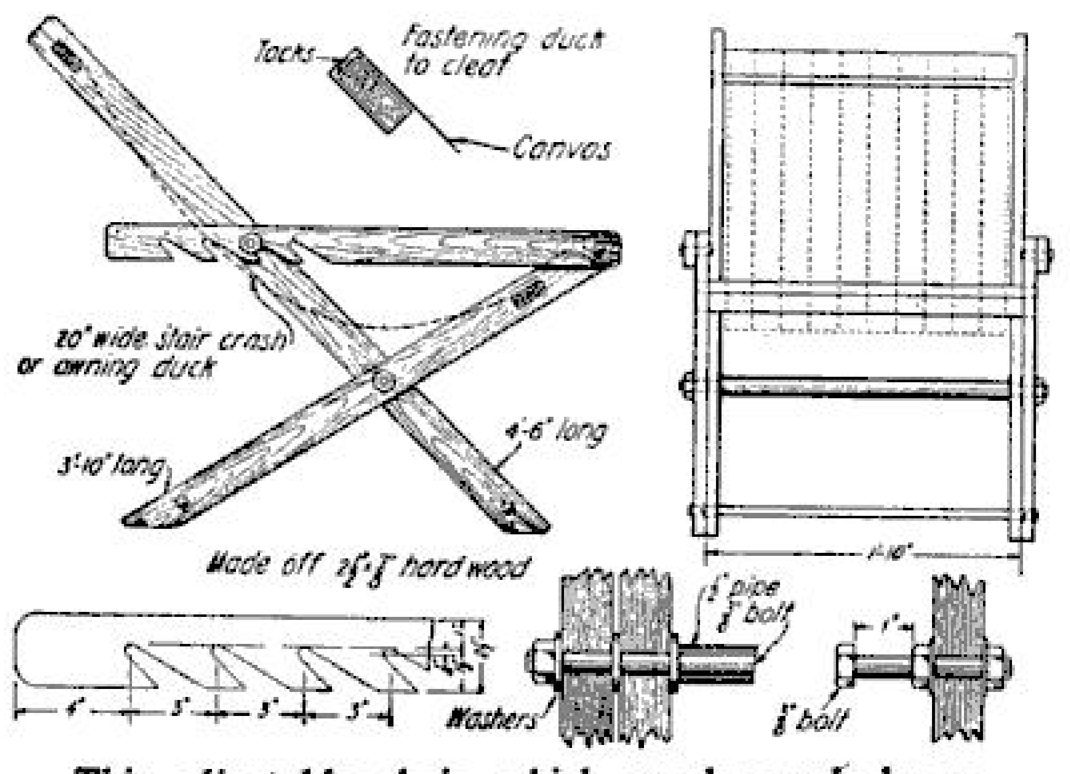
To make the chair shown cut two strips 4 1/6 ins. long, and two strips say forty to forty-six inches long. Mortise near top of the two long strips for the crossbar. Cut the mortise 7/8 in. by 2 ins. in size. The crossbar is 1 ft. 1/10 ins. long with a 1/4-in. shoulder on each side at each end 7/8 in. long.

At the other end bore a 3/4-in. hole in each strip and fit a 7/8-in. dowel into it. This dowel is also 1 ft. 1/10 ins. long. All these joints should be carefully squared, fitted tight, glued and wedged. Glue the wedges before you drive them, and make chisel-splits for starting the wedges. Do the same thing to the shorter pieces. Bore a 3/8-in. hole in both short pieces at the upper end. This is for the bolt holding the arm-rest. Cut out the arm-rests, as shown in the illustration, for the adjustable hooks. These hooks are made by boring 1/2-in. holes in the exact center of the strip and making saw-cuts to remove the wedge of wood. Round both ends and also round the top ends of the shorter frame.

Lay off fifteen inches from the bottom of the long frame, and twenty-five inches from the bottom of the short frame. Bore 3/8-in. holes in both, at the points marked. The steel pivot rod, 3/8-in. diameter, is twenty-five inches long. It is threaded on each end for a hexagon nut. Six 3/8-in. common washers, and a piece of 1/2-in. wrought-iron pipe 1 ft. 8 ins. long are required.

Put the rod through the hole in the short frame. Put on a washer; then through the hole in the long frame, another washer; slip on the piece of pipe; a washer; hole in the long frame; a washer; hole in short frame; another washer. Put a washer on the outside of the short frame, and put on both nuts; screw up fairly tight, and burr the end of the rod, riveting it down on the nuts, so they cannot back off.

Pivot the arm-rest in the hole at the top of the short frame, with a 3/8-in. bolt 2 1/4 ins. long under the head, but make it a loose fit, and burr down the threads to keep the nut in place. Bore a hole through the side-bars of the long frame, 2 ft 3 ins. from the top. Put into each hole a 3/8-in. bolt, 2 3/4 ins. long under the head, with a thread 2 ins. long. Screw up a nut on this thread until it joins. Push the thread through the bored hole from the outside, screw up the other nut tight, and burr the threads. The notches in the arm-bar hook on this bolt and make the chair adjustable.



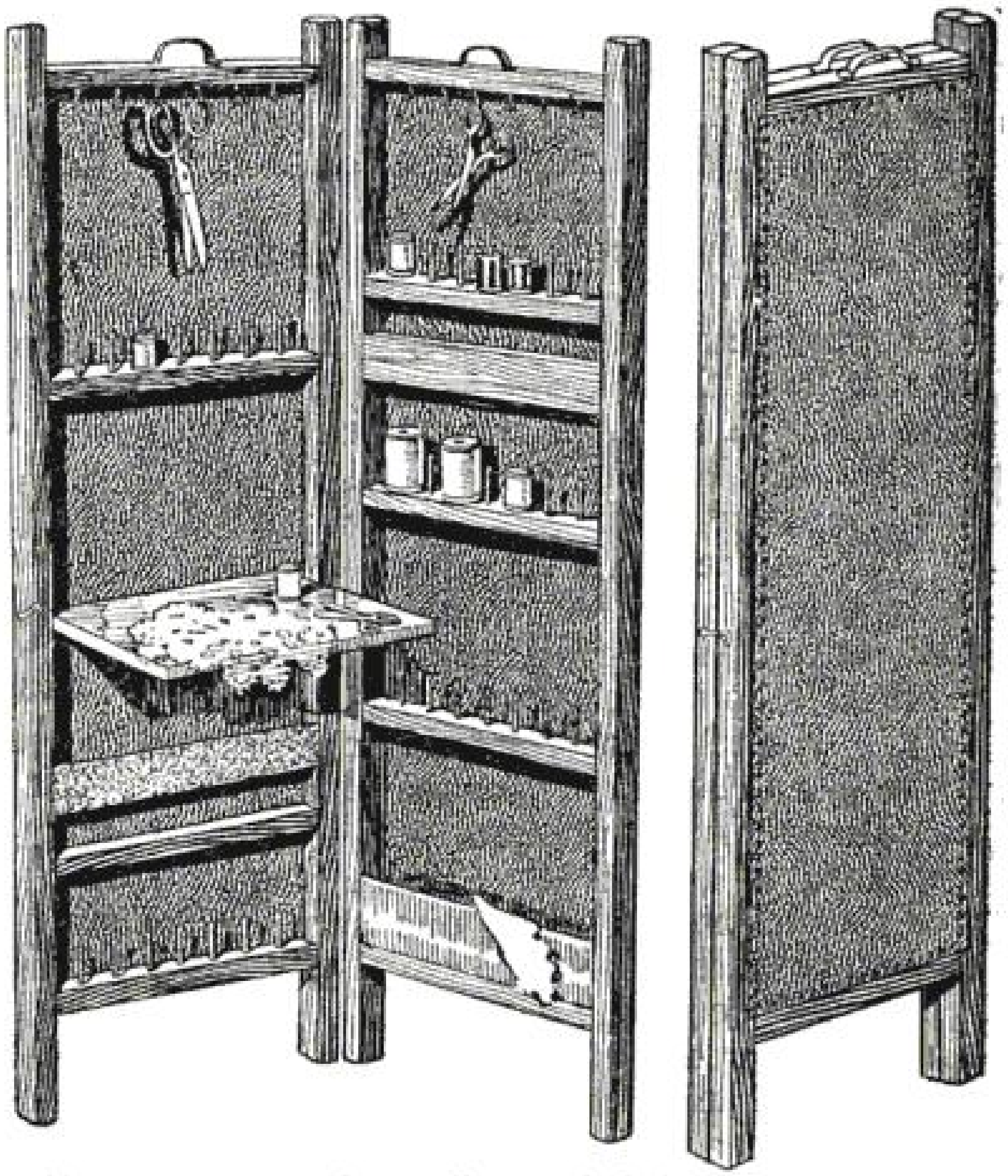
This adjustable chair, which can be made by an amateur from ordinary materials, forms an attractive summer feature of the lawn

Fasten the crash or canvas to the crossbars with tacks, tacking on top, and taking a full wrap of the canvas around the crossbar so that the tacks are covered. This prevents strain on the tacks when the chair is in use. Allow slack as shown, so that the body of the sitter cannot touch the crossrod. The canvas will conform to the body like a hammock. The chair should be painted or varnished for protection against the elements.

This practical lawn chair can be subjected to much wear and tear without suffering any damage.—H. S. RINKER.

How to Make a Sewing-Screen

INSTEAD of a workbasket, with spools of thread, buttons, scissors, embroidery, hoops, etc., all crowded into a small space, a screen can be used, which has a definite place for every article used in sewing. The spools of thread are kept on brass pegs; the silks in one place and the cottons in another. The scissors, pincushion and emery ball are suspended from hooks. Patterns, embroidery-hoops,buttons,etc., all have pockets where they are readily accessible and yet kept in good shape. Best of all, the screen is light and can be easily carried from one room to another, or on to the veranda. In sewing, a small shelf may be lowered for holding the work. With a few materials anyone handy with tools can make this ornamental and useful piece of furniture. The materials needed are as follows:



The screen can be easily carried from one room to another, or on to the veranda

WOOD FOR FRAME

4 pieces 42 ins. by 1½ ins. by ¾ in.
9 " 12¼ ins. by 1½ ins. by ¾ in.
1 " 12⅛ ins. by 9 ins. by ½ in.
1 " 12¼ ins. by 3¼ ins. by ¼ in.
1 " 12¼ ins. by 1¾ ins. by ¼ in.
1 " 12¼ ins. by ¾ in. by ¼ in.

LEATHER FOR COVERING

2 pieces 13¾ ins. by 36 ins.
1 " 13¾ ins. by 8 ins.
1 " 13¾ ins. by 4 ins.

35 brass pins, 2 ins. long	4 short screws
2 hinges; and screws	12 hooks
1 hook and eyebolt	100 fancy tacks
2 handles; and screws	50 nails

Select two of the longer or upright pieces, and on them indicate with a pencil the points for attaching the cross-pieces. Suppose the left-hand side of the screen is to be made first. The upper edge of the uppermost cross-piece should be 1½ ins. from the tops of the posts. The top surface of the next lower cross-piece should be 13¼ ins. from the tops of the posts. The one next the bottom is 31½ ins. from the top; and the under surface of the bottom piece is 4¼ ins. from the floor.

On two of the cross-pieces drive seven long brass pins an equal distance apart, as shown in the illustration, taking care to have their tops all even. It is better to drill holes slightly smaller than the pegs before putting them in, especially if the wood is oak or other hard wood. Into the under surface of the top cross-piece screw seven eyebolts, as shown.

Next, assemble the posts and cross-pieces. Use fine wire nails, being careful not to split the wood. Strong hot glue should be applied at the same time to secure greater strength. Before proceeding allow the work to become thoroughly dry.

On the inside of each of the two upright posts, about ⅜ in. from the back edge and 22 ins. from the top, insert a screw, allowing it to protrude about ¼ in. Then, holding the shelf, which is the rectangular piece, 12 ⅛ ins. x 9 ins.

x ½ in., in position, with its upper edge just under these screws, locate the two points for its pivoting screws. This is clearly shown in the illustration. The pivoting screws will work more easily if the holes are first made with a slightly larger screw. The back screws hold the shelf in a horizontal position when it is being used. At other times, it can be raised to a vertical position between the posts.

The top and bottom pieces on the right side have the same location as those on the left. The second cross-piece is 10 ins. from the tops of the posts. Just under it is attached the piece 12¼ x 3¼ x ¼. This piece does not need to be nailed; glue will answer. Attached to its under edge and projecting forward horizontally, is the narrow strip, 12¼ x ¾ x ¼. Attached to the front edge of this piece, and slanting forward obliquely, as shown in the illustration, is the piece, 12¼ x 1¾ x ¼. These three pieces should be nailed to one another with two or three fine wire nails, which can be readily concealed.

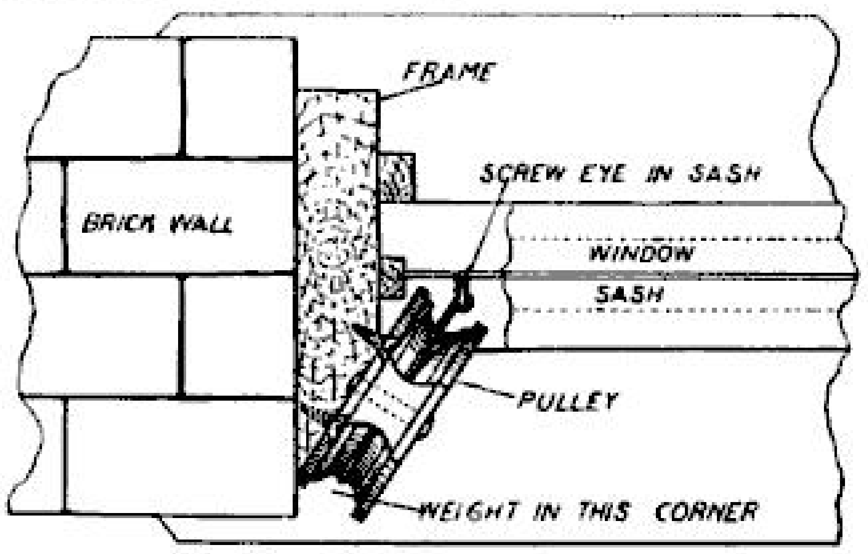
The third cross-piece on the right is 18½ ins. and the fourth piece 27 ins. respectively, measured from the tops of the posts. Before joining them to the uprights, they should be fitted with brass pins, as shown. The top piece should be provided with hooks.

Before proceeding further, the various parts should be varnished, stained or painted, according to individual taste. If the screen is to be used in a bedroom having white woodwork, white enamel may be used to advantage. If the woodwork is mahogany or oak, the screen can be finished to match. After the parts are thoroughly dry, the leather or other covering is put on. If leather is used, it should match not only the finish of the screen, but the color scheme of the room. If white enamel is used, a pretty chintz pattern is very effective as a covering, or silk may be used. In putting on the leather or chintz, be careful to stretch it tightly over the frame, gradually proceeding from top to bottom, inserting the tacks on both sides simultaneously. The edges should be folded in about ¼ in.; and the tacks should be driven into the middle of the frame. If silk is used, it may be shirred on a cord at the top and bottom, instead of being tacked. The two inside strips which form the pockets at the bottoms are attached by turning in their edges and tacking on the inside. The measurements given are large enough to allow for folding in the upper edges several inches.

Lastly, fasten two small brass hinges on the back, 7½ ins. from the top and bottom, respectively. On the front, attach a hook and eyebolt, 18½ ins. from the top, for holding the two parts of the screen together when not in use. On the top cross-pieces fasten two brass handles, as shown. They should be near the front inner edge of the frame, so that they will come together when the screen is closed.

Fitting Windows With Weights

IN the illustration is shown the way in which seventy-five windows in a factory building were fitted with sash cords, pulleys and weights. The method is simple, inexpensive, neat and the pulleys and weights are out of the way. The upper end of the window frame is cut away at an angle as shown, just enough to make a seat for the pulley. This brings the weight in the corner at the inside edge of the window frame and against the building wall. The other end of the rope is fastened to a screw-eye in the top of the window sash. These weights, when out of order can be repaired by anyone.—M. E. DUGGAN.



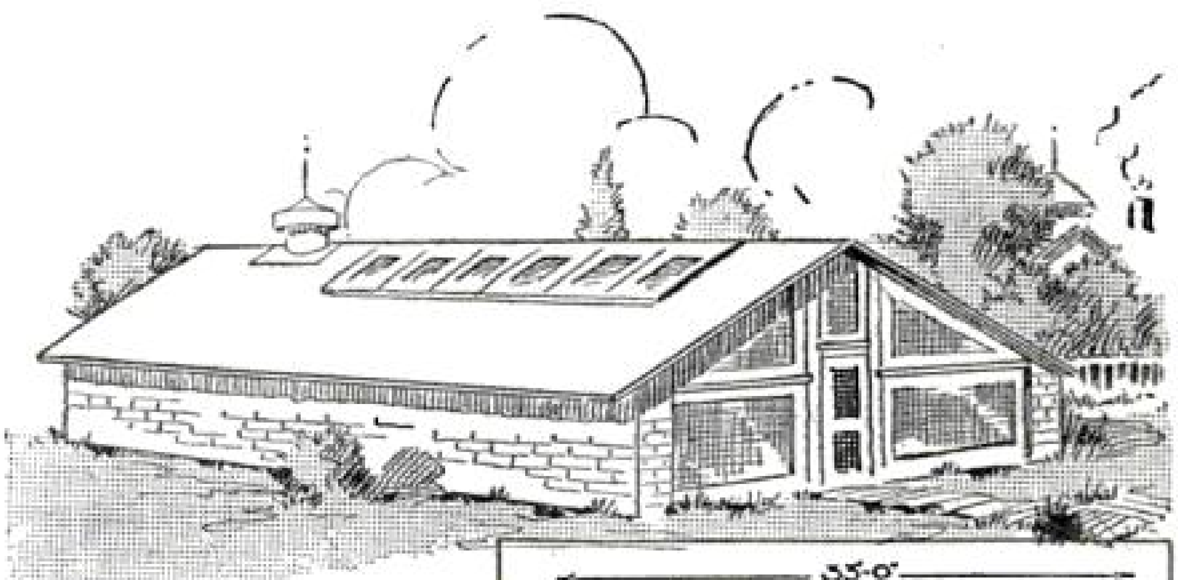
An efficient window device

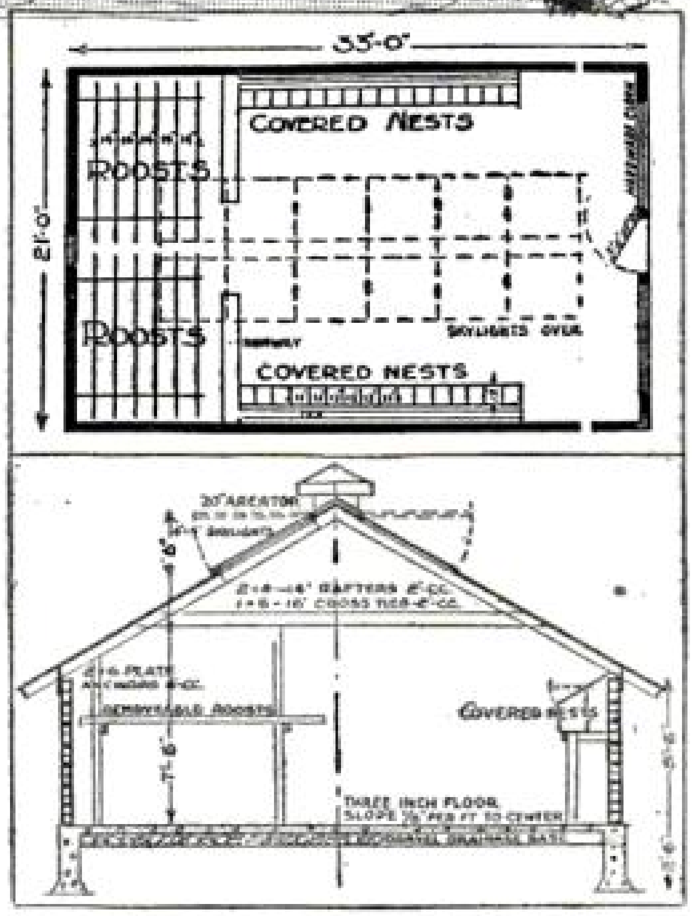
How to Remove Iodine Stains

THE dark brown stains caused by iodine are unaffected by soap or other cleaning substance. To remove, let the article soak over night in starchy water, which will remove all trace of the stain.—R. L. BIRD.

Building a Poultry-House with a Skylight

SOMETHING out of the ordinary in poultry-house construction is shown in the accompanying plans. All the windows are in the roof. The house stands the long way, north and south, so that during the day the sun's rays will reach all parts of the coop. The secret of building poultry-houses right is largely a matter of admitting the greatest possible amount of sunlight. In the plan shown this factor is well cared for.





A poultry-house which considers the interests of the hens is here described. All the windows are in the roof. The walls are of hollow tile, the floor is of concrete and a galvanized-iron ventilator furnishes fresh air. Poultry-houses should admit the greatest possible amount of fresh air

This house is 21 ft. by 33 ft., with eaves 5½ ft. from the grade. The walls are of hollow clay tile and 5 ins. thick. The foundation and the floor are of concrete mixed 1:3:5.

The structure has a simple gable roof covered with prepared roofing. The roof is at third pitch; rafters at 2 ft. centers. Matched sheathing is used as a roof foundation. Every other skylight sash—on both sides of the peak of the roof—is hinged to be opened for ventilation and airing. A 20-in. galvanized ventilator is placed at the rear, and in the rear gable-end is a barn-sash, which is hinged to swing up.

A coop of this size will comfortably shelter more than a hundred full-grown birds. The covered nests are built in along the side walls, and the roosts are all at the rear end of the house. Materials, such as lumber, tile, and cement, as listed herewith, will be needed:

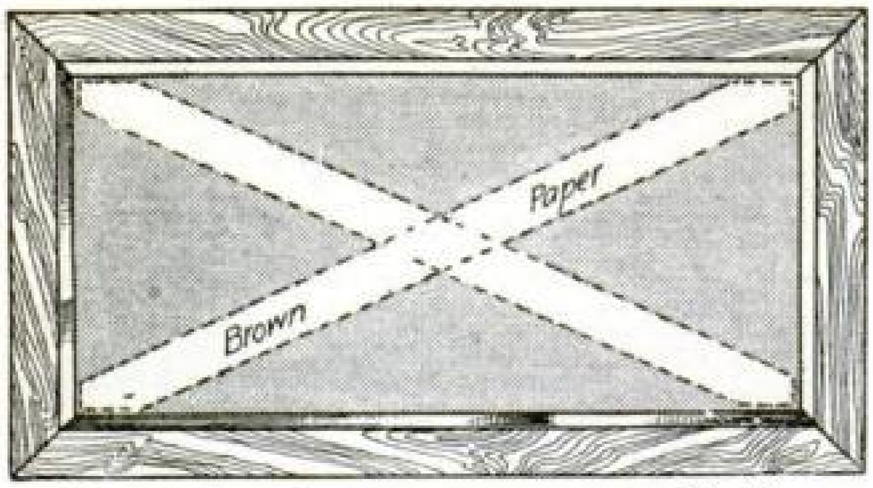
17 bbls. cement for floor and footing	$24.00
8 yards clean, coarse, sharp sand	8.00
12 yards well-graded gravel or stone	12.00
650 hollow clay building-blocks	26.00
1 dozen anchor-bolts 5-8 in. by 12 ins.	1.00
4 pcs. 2 ins. by 6 ins. by 16 ft. for plates	
35 pcs. 2 ins. by 4 ins. by 14 ft. for rafters	
16 pcs. 1 in. by 6 ins. by 16 ft. for cross-ties	17.00
1000 ft. 8-inch ship-lap for sheathing	30.00
8 squares three-ply roofing material	24.00
12 skylight-sash 4 ft. by 4 ft.	24.00
1 barn-sash for rear, 4 lts. 10 ins. by 12 ins.	1.00
1 galvanized metal ventilator 20 ins.	12.00
200 ft. lineal 1 in. by 4 ins. finish lumber	2.00
125 ft. lineal 1 in. by 6 ins. finish lumber	2.00
36 ft. galvanized metal ridge-roll	2.00
1 screen door 3 ft. by 7 ft.	2.00
125 sq. ft. 1-2 inch hardware cloth	6.00
24 pcs. 2 ins. by 4 ins. by 10 ft. for roosts and supports	
5 pcs. 1 in. by 12 ins. by 16 ft. for nests	7.00
Total	$200.00

W. E. FRUDDEN.

Some Curtain Suggestions

SEW two small rust-proof hooks at the extreme lower corners of your lace curtains on the right side. On sweeping day or when you wish the windows open, hook them up any desired height out of the way. The weight will not stretch the mesh in the least.

Use small round wooden toothpicks to pin your curtains to the rod, and avoid the unsightly rust spots made by common pins by sewing on small bone or brass rings of substantial design.



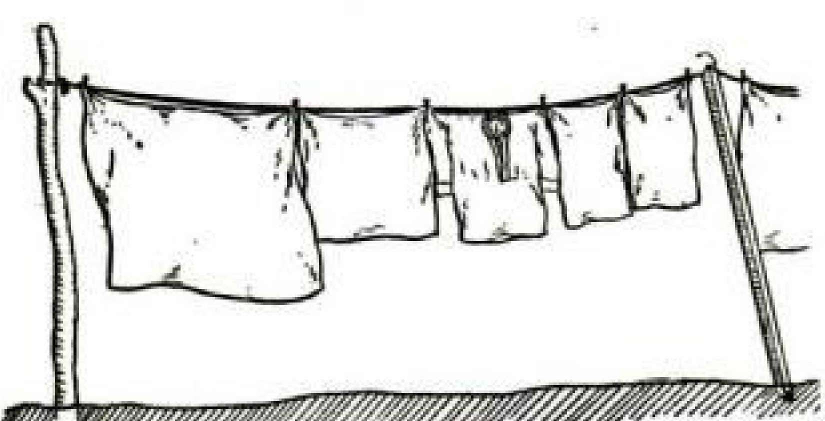
Two strips of strong paper are an effective means of protecting a mirror from breaking

How to Pack Mirrors to Prevent Breaking

WHEN mirrors are to be stored or to be shipped by mail, they may be securely packed in the following manner: Carefully paste two strips of stout brown paper diagonally across the mirror, as shown in the illustration. In the case of very large mirrors, use several strips of paper. Then wrap carefully in heavy Manila paper.—G. H. HOLDEN.

A Clothes-Line Prop That Will Not Drop or Slip

AN improvement over the ordinary clothes-line prop is shown in the accompanying figure. It is made of spruce, 1¼ in. by 2 ins., and as long as needed. A hole is cut at the top, as shown. This allows the user to raise or lower the line without allowing the prop to fall. Yet it can be detached readily. The slanting cut at the bottom prevents slipping on the ground and the point may be shod with a piece of hoop-iron.—JAMES E. NOBLE.



This prop is stable yet detachable

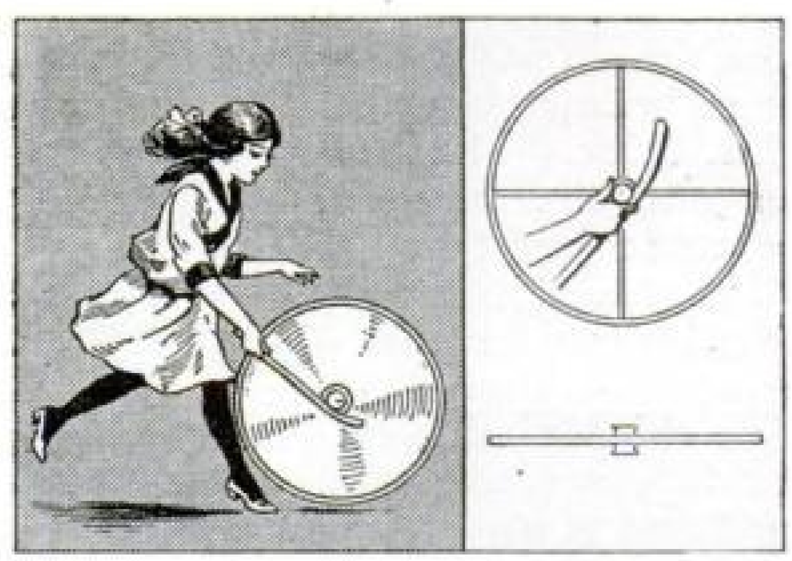
A piece of hoop-iron strengthens the lower end. An L-shaped notch at the upper end holds the line securely

A Hoop with a Guiding Hub

THE attached drawings illustrate an improvement over the old-style hoop.

Instead of a plain hoop, four spokes with a hub are added, and in place of the plain, straight stick, for giving the hoop motion, a stick with a slight up-curve at one end is used.

This hoop may be started from the hand as well as stopped and picked up without stooping, and is at all times under control. Motion to the hoop is given by pushing it along as shown at the left in the illustration below. A straight view of hoop, with a notch for the stick on either side of hub, is also shown, as well as the method of holding, starting and picking up the hoop by means of this curved stick.



An ingenious hoop has a hub for guiding

Wood Blocks for Flooring

CREOSOTED wood blocks, already extensively used as paving material for city streets, have been coming into use as flooring for the last four or five years. Durability, noiselessness under heavy traffic, and sanitary properties are chief advantages for paving and also give special value for making floors, especially for use where heavy trucking, the moving of heavy machinery, or other severe use makes the maintenance of floors a serious problem. The rather high cost is the chief disadvantage in the use of wood blocks.

Wood blocks are now widely used for flooring in factories, warehouses, machine shops, foundries, various types of platforms, wharves, and docks, and for such miscellaneous purposes as hotel kitchens, hospitals, laundries, and slaughter houses.

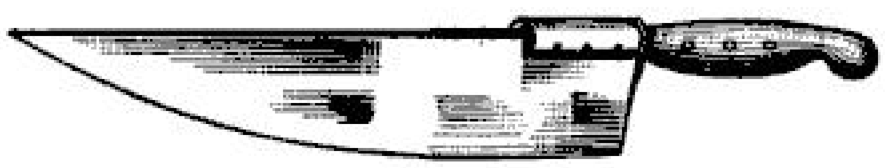
Finding the Right-Sized Nail

HAVE you ever hunted for a nail of a certain size and finally used one that was either too small or too large? You probably have, though a case could be made which would obviate all such difficulties. A deep box, of convenient size for carrying around, and filled with trays partitioned off to hold the different sizes, makes a good case. In the top tray, place the nails which you are most likely to need. They should also have the largest compartments.

If a stationary case is desired, a sort of cupboard with pigeon-holes can be attached to the wall of the barn or garage. A wooden strip about an inch and a half in width, can be tacked along the bottom of the pigeon-holes to keep the nails from rolling out.

Improving a Kitchen Knife

COOKS in hotels and restaurants are much annoyed by the use of light American-made "French knives," which when used for any length of time each



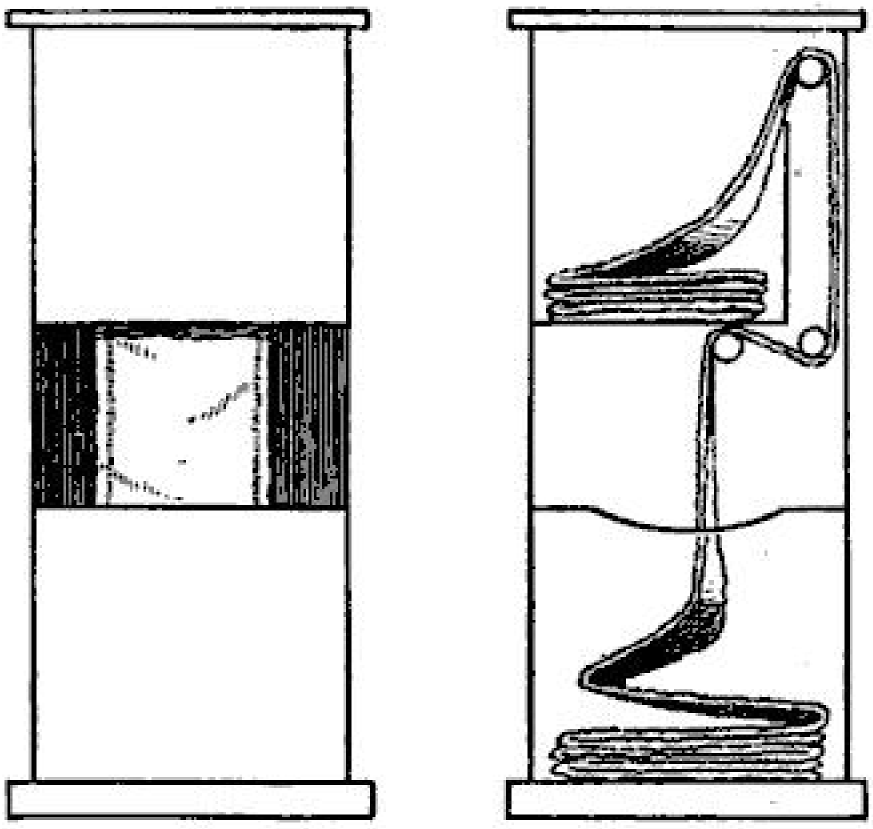
A piece of wood fitted on to the back of a knife-blade saves pressure on the hand

day form a calloused place on the forefinger. To remedy this condition the writer has thought of a little device which helps considerably. Take a short length of dowel, saw a groove in it, and slip it in close to the handle. It may be riveted on if desired, as shown in the illustration.—PAUL REX.

An Improved Roller-Towel

A NEW arrangement for roller-towels consists of an upright frame attached to the wall. It has two boxes, one at the top and one at the bottom, with a space of 2 ft. between them. The folded towel is stored in the upper box, from which it descends over rollers to the lower box. The towel is used in the space between the boxes. By drawing on the towel, a fresh portion can be had at all times.

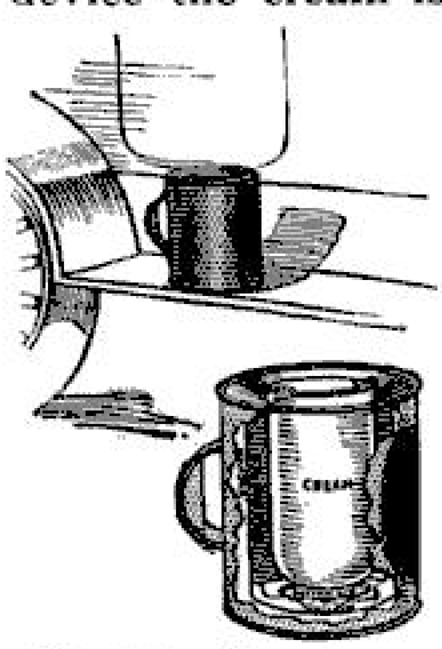
Not only is this towel arrangement desirable for hotels, restaurants, clubs and the like, but it is also perfectly suitable for a private bathroom in the home.—F. P. MANN.



This towel rack presents a fresh portion of the towel at all times

Let Your Ice-Cream Freeze While Motoring

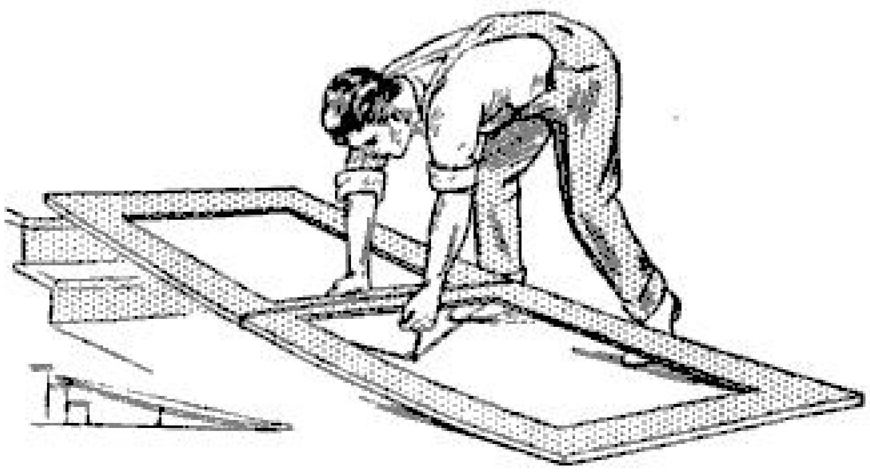
A VACUUM freezer which will freeze cream automatically in half an hour, and keep it frozen for eight hours, is a recent addition to modern picnicking equipment. The vacuum between the outer wall and the ice compartment causes the ice to spend all of its force on the cream, thus insuring more speed and less cost than the old method. One filling of ice will freeze two fillings of cream. In using this new device the cream is poured in one end and the ice and salt in the other, thus preventing any possibility of grains of salt in the ice-cream. If the freezing is begun when a motoring party leaves home, the ice-cream will be ready when they reach the picnic ground. The freezer, being made of white enamel-ware, is sanitary and clean.



A vacuum ice-cream freezer

To Screen Doors and Windows

IN screening doors and windows, it is highly desirable that the wire screens should not bulge or wrinkle, and that they should be as taut as possible between the frames. In the accompanying illustration, a method is shown for accomplishing this. One end of the door or frame to be screened is made



Here is a simple way of stretching a screen taut on a frame

to rest on the steps, and the other rests on the floor or walk. By means of a piece of wire or cord and the screw-eye in the floor, the center of the door is sprung so that it is held 3" or 4" below the sides. The door must be held in this sprung position until the wire screen has been completely tacked in place. The tacking should begin at the center and proceed to the corners of the frame. When the tacking is completed, the door or frame can be released from its taut position; and it will be found that a neat job, with a well-stretched screen free from wrinkles and bulges, will be the result.—E. B. WILLIAMS.

A Home-Made Table-Top Varnish

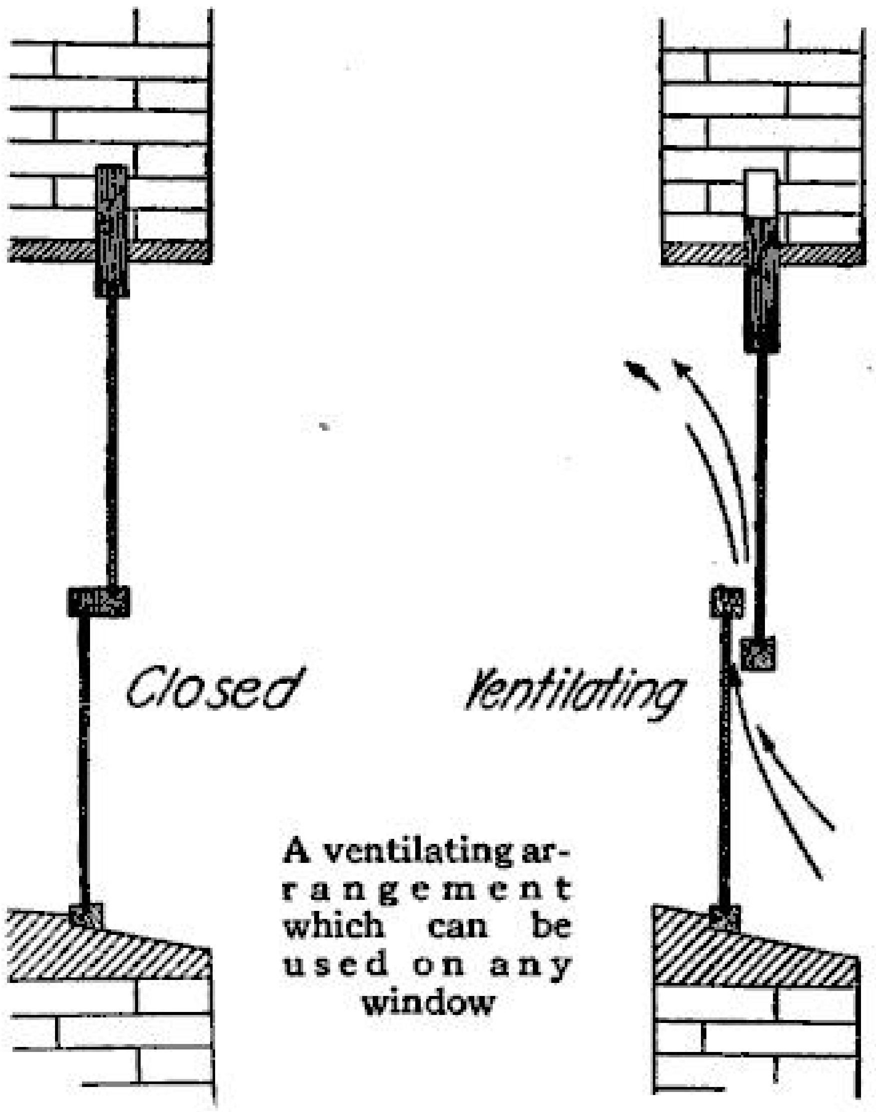
FOLLOWING is a recipe for a good varnish, suitable for experimental and wireless benches, and also for instrument bases. It gives a finish very much like hard rubber:

Mix enough lampblack with shellac to make the mixture black, but not enough to thicken it much. After sandpapering the wood smooth, apply two coats of the varnish, sandpapering lightly after each coat. Over this put one or two coats of dull varnish. This makes the wood waterproof, preserves it, and improves the appearance of the table-top.

Concealed Ventilation

THE diagram shows a simple scheme of ventilation, which may be employed on any window by extending the top of the upper half so that it pockets higher into the wall. When the window is in position for ventilating, the top is pulled down slightly, as shown in Fig. 1. This permits air to enter through the "middle joint," as indicated by the arrows, and it is deflected upward, just as it should be. The top, it will be noted, is still sealed.

The appearance of the window when closed is shown in Fig. 2. It always looks like an ordinary window, and the absence of any attachment makes it the acme of simplicity.



A ventilating arrangement which can be used on any window

Fig. 1 Fig. 2

Removing Heat Spots from a Table

THE white spots, caused by hot dishes, can be removed by rubbing fresh lard on them. The lard should be rubbed in with the fingers. If the spots are very bad it will be necessary to leave the lard on a few hours. It is then rubbed off with a soft cloth. The lard will not injure the finish of the table. A finely polished dining-table, otherwise ruined by hot dishes, can be thus reclaimed.

A Merry-Go-Round Swing

A MERRY-GO-ROUND swing is easy to make if the following directions are carefully observed.

The necessary materials and their exact measurements are as follows:

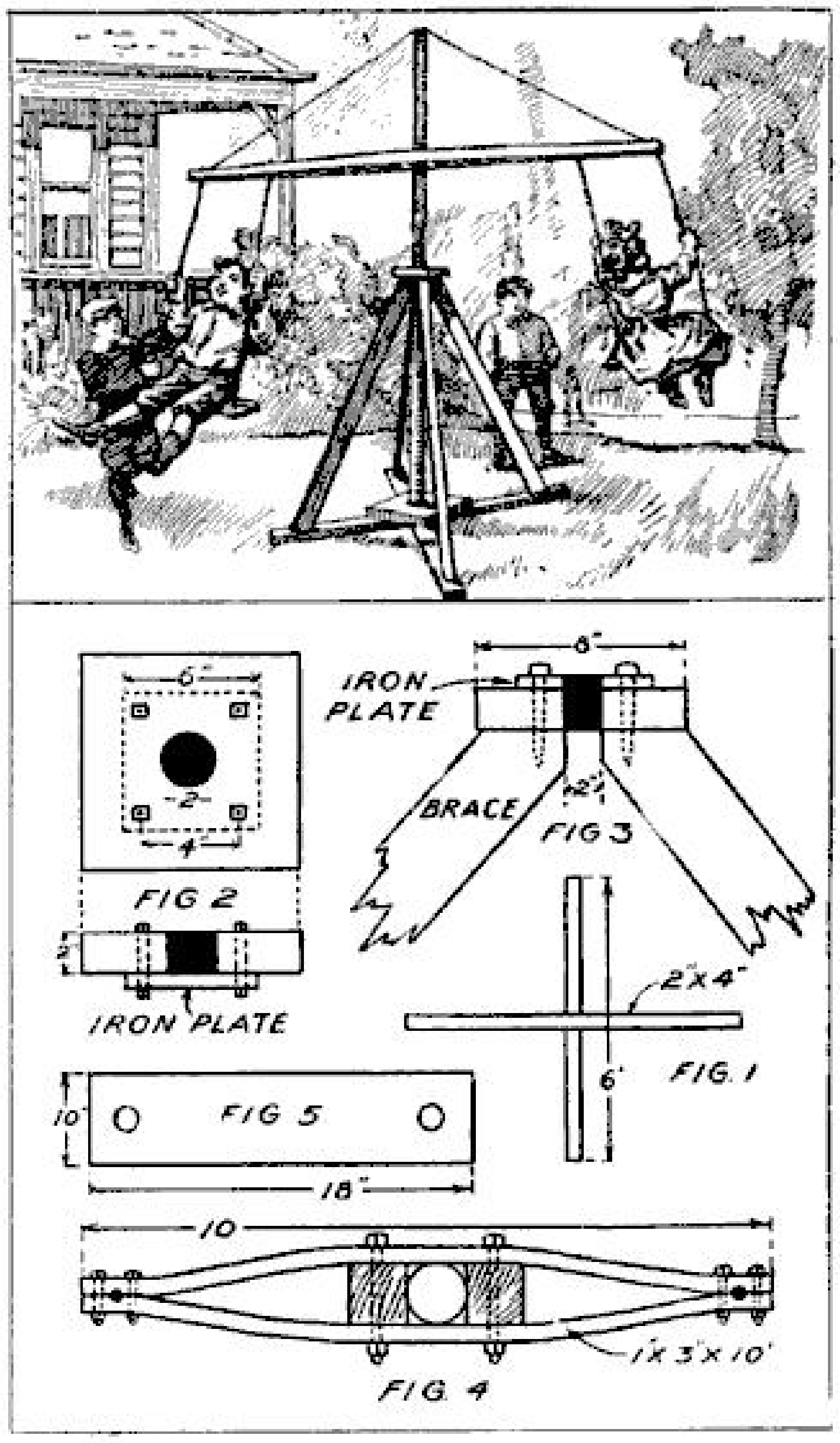
1 pipe 2 ins. by 8 ft. .... For vertical shaft
2 pcs. 1 in. by 3 ins. by 10 ft. ..... For cross-arm
2 iron rods ¼ in. by 6 ft. ..... For cross-arm guys
2 pcs. 2 ins. by 4 ins. by 6 ft. . For foundation cross
4 pcs. 2 ins. by 2 ins. by 4 ft. 3 ins. .... For center bearing braces
2 pcs. 2 ins. by 8 ins. by 8 ins. (oak).... For bearings
2 iron plates 6 ins. by 6 ins. .... For bearings
2 machine bolts ¼ in. by 2½ ins. . For top bearing
4 machine bolts ¼ in. by 4½ ins. .... For bottom bearing
4 lag-screws ¼ in. by 3 ins. ..... For top bearing
4 carriage bolts ¼ in. by 2½ ins. . . For cross-arm ends (2 to each end)
2 carriage bolts ¼ in. by 4½ ins. .... For cross-arm center blocks
2 pcs. 1 in. by 10 ins. by 18 ins. .... For seats
16 ft. Manila rope. .... For swings

Any soft wood will be suitable.

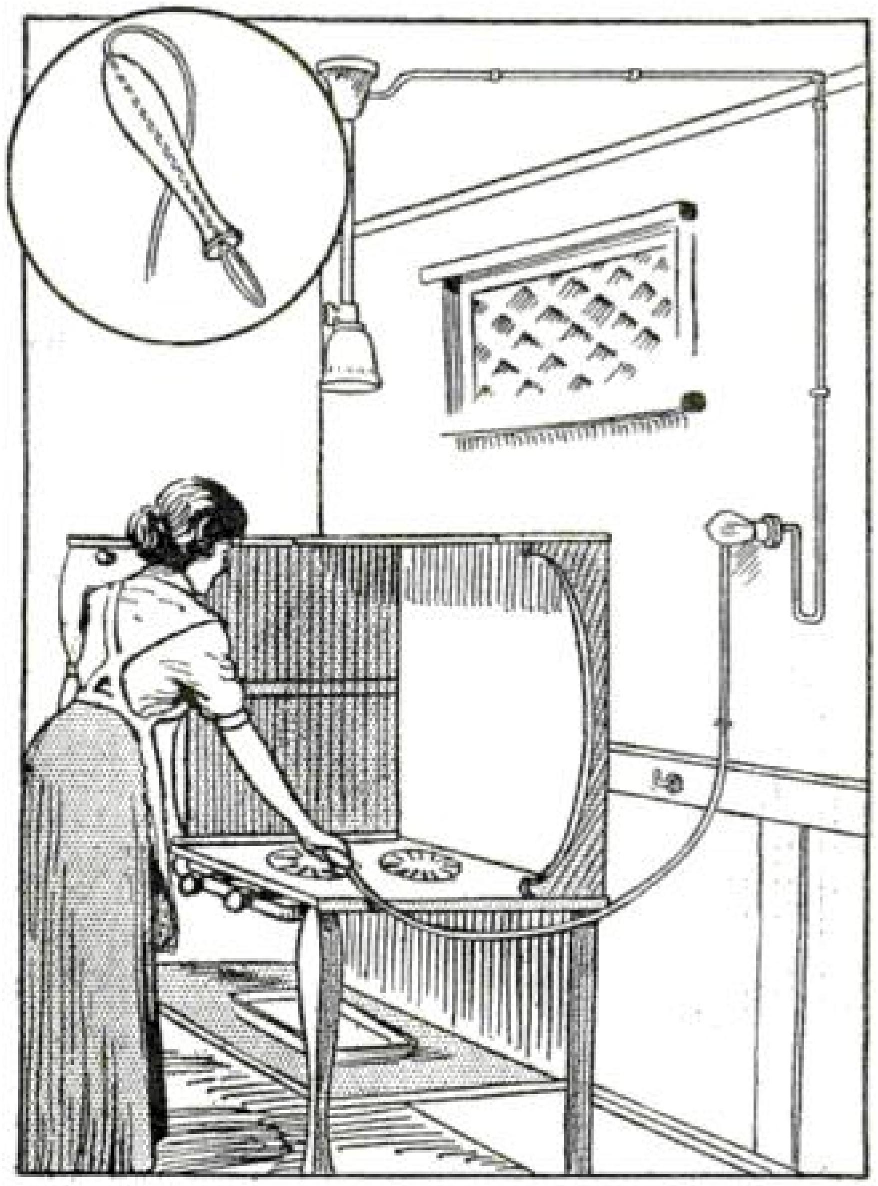
Begin with the foundation-cross, Fig. 1. Find the center of the two cross-pieces; half notch them to fit flush, and nail together. The foundation-cross is then ready to receive the bottom bearing, Fig. 2. Bore a hole 2¼ ins. in diameter in the center of the block. Bolt one of the iron plates between the block and the foundation-cross, using two machine bolts 4½ ins. long. This completes the foundation-cross and bottom bearing. The top bearing is made the same as the bottom bearing, only the hole runs through the iron plate.

The four braces are sawed at the ends to an angle of forty-five degrees, and firmly nailed to the ends of the foundation-cross, thus bringing the ends together at the top. Next, the top bearing is firmly screwed on the end of the braces, using four ¼-in. by 3-in. lag-screws, taking care first to bore the holes with a gimlet. Now we will put the center shaft into place. If a pipe of the given dimension is not available an old boiler-tube of the same dimensions will answer the purpose. For the cross-arm Fig. 4, the two pieces of the dimensions above given are bolted together at the ends, using two bolts to each end.

Now bolt two blocks 1 in. on each side of the center, the blocks to be 2 ins. thick. Thus we have a hole 2 ins. square, enough space for the center shaft to run through. Now bore a ¼-in. hole at each end of the arms to receive the stay-rods, which are threaded at one end only, the other end being bent in the shape of a hook to catch on the rim of the center shaft. Now slip the cross-arm over the shaft, bolt the ends of the rods to the ends of the arms, and hook the other ends on the shaft. Make the two boards for the swing seats Fig. 5, with the dimensions already given; bore a ½-in. hole at the ends of the boards to receive the rope. Now run the rope through the holes and knot them so that they will not slip out of place, the swings being tied to the cross-arm. The merry-go-round swing is now complete and can be set firmly by driving stakes into the ground at the end of the foundation-cross and securely nailing them.—O. B. LAURENT.



This open-air swing can vie with the Pied Piper of Hamlin



An electrical attachment for lighting the gas-range can be installed in any kitchen

How to Make a Practical Gas-Range Lighter

THE following gas-range lighter is one in which there are no parts to get out of order, no coils and no batteries. Once installed it will last for years without attention. The illustration will serve to show how the connections are to be made. In detail they are as follows:

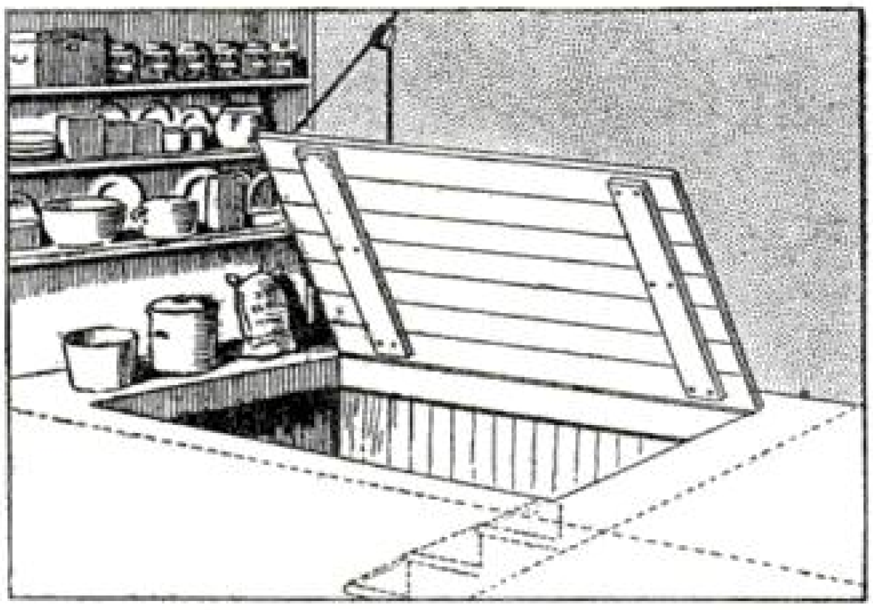
Procure a 250-watt bulb, or, if not available, a 100-watt bulb will answer the purpose for a 110-volt direct-current circuit, which is the current generally supplied to homes. Obtain a socket, two pieces of single-strand flexible cord and a wooden handle through which there has been made a hole. Connect the two wires to the socket and extend one end of the wire over to the chandelier in the kitchen and connect this to one of the wires inside the canopy at the top, being careful to clean both by scraping with a knife. Be sure to replace the insulation. Then place the bulb in the socket. Turn on the current and touch the gas-range with the free end from the bulb. If the light burns, the connection at the chandelier has been made correctly. If not, disconnect the wire and connect it with the other wire at the chandelier. The light will then burn when connected with the range as before.

Now suspend the light from the ceiling. Run the end of the cable through the handle and solder to the end of it a piece of heavy copper wire in the shape of a ring. Push back into the handle until it is tight.

To light the gas-range, all that is necessary is to turn on the gas, take down the handle and touch the range at the point where the gas is issuing and it will light immediately. Light may also be used as an auxiliary by leaving it connected to the range. This arrangement will light the stove 10,000 times, for from ten to twelve cents' worth of current. This will not work on a stove that is connected to the main by means of a rubber hose, unless there is a wire connected to the stove and to a gaspipe in addition to the apparatus just described. This device works just as well on an ordinary gas-jet as on the range.—C. B. CLOUD.

Making the Cellarway Serve Two Purposes

IN a small house shelf space for storage was scarce and the following plan was made available for shelving the wall of the inside stairs to the cellar. A hinged door was made to fit over the stair-well and to fold back against the wall when the stairs are in use. A pulley and weight move the drop door easily and make of it a temporary floor upon which one may walk to reach the shelves. The use of the pulley is not necessary, provided the door is made of some light, soft wood.



This stairway saves space

For Cleaning Leather Upholstery

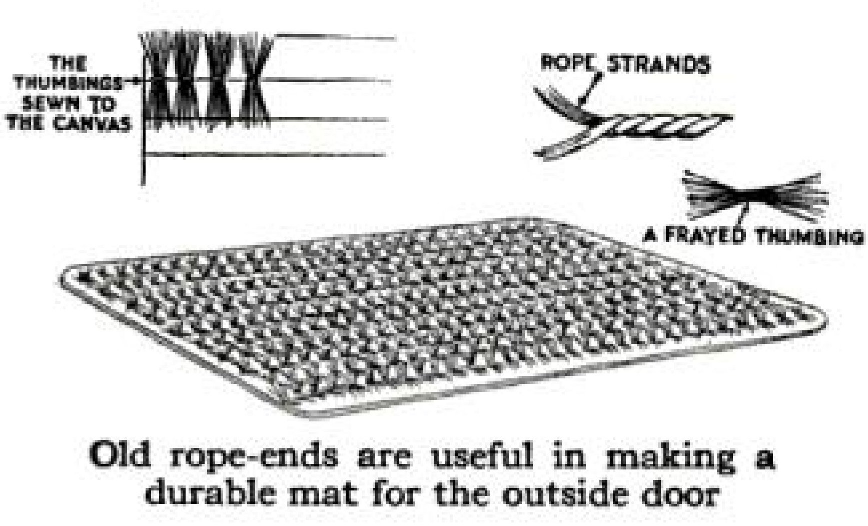
HOUSEWIVES are apt to use most any kind of oil, grease or even furniture polish on the leather upholstering of their furniture, and frequently with very bad results. The oils soil the clothing and the polish ruins the leather.

To overcome this trouble a sales manager of a large eastern furniture house made tests of many fluids prepared for the purpose, some of which were very satisfactory. Finally a chemist was consulted, and the reply was, "Use sweet milk." The furniture house immediately tried the use of mopping the upholstering with milk, and the results were very gratifying. The leather should be gone over three times annually, and after being smeared for several minutes, the milk should be wiped off with a clean cloth. The leather will be sufficiently oiled, thoroughly cleansed and will not soil the clothing.

How to Make a Door-Mat from Old Rope-Ends

TAKE a piece of canvas about 18 ins. by 30 ins., hem it all around and mark it off in lines about 1¼ ins. apart. After you have marked the canvas, take old rope, spread it out, and cut the strands into pieces 4 ins. long. These pieces are called "thumbings." Fray both ends of these thumbings and you are ready to start sewing. Use a heavy sail or sack needle and sew these thumbings through the middle to the canvas, using the "back-stitch."

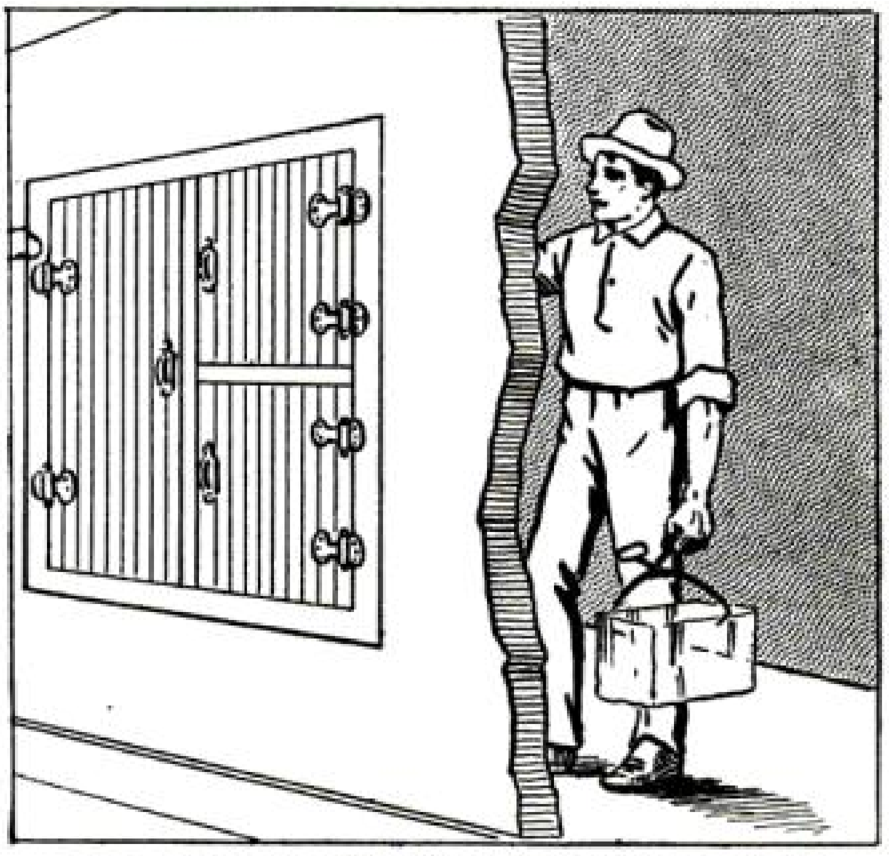
When sewing, follow the lines on the canvas and sew the thumbings close; draw your thread tight. When you have finished you will have a door mat that will clean dirty or muddy shoes better than any mat on the market and it will last longer.



Old rope-ends are useful in making a durable mat for the outside door

A Back-Saving Refrigerator

AN unusual idea has been carried out in a new home in Iowa, where the housewife believes in having kitchen storage places as near as possible to waist-height, to prevent wearisome stooping or stretching. Not only the utensil and china cupboards, but also the built-



Ice can be admitted through outside doors with no inconvenience

in refrigerator is located above the floor. This refrigerator is set into the kitchen wall and is iced from the back entry. Its base is about 30 ins. from the floor. The convenience of the iceman, who must lift the ice, is served by steps in the outside hall.—A. G. VESTAL.

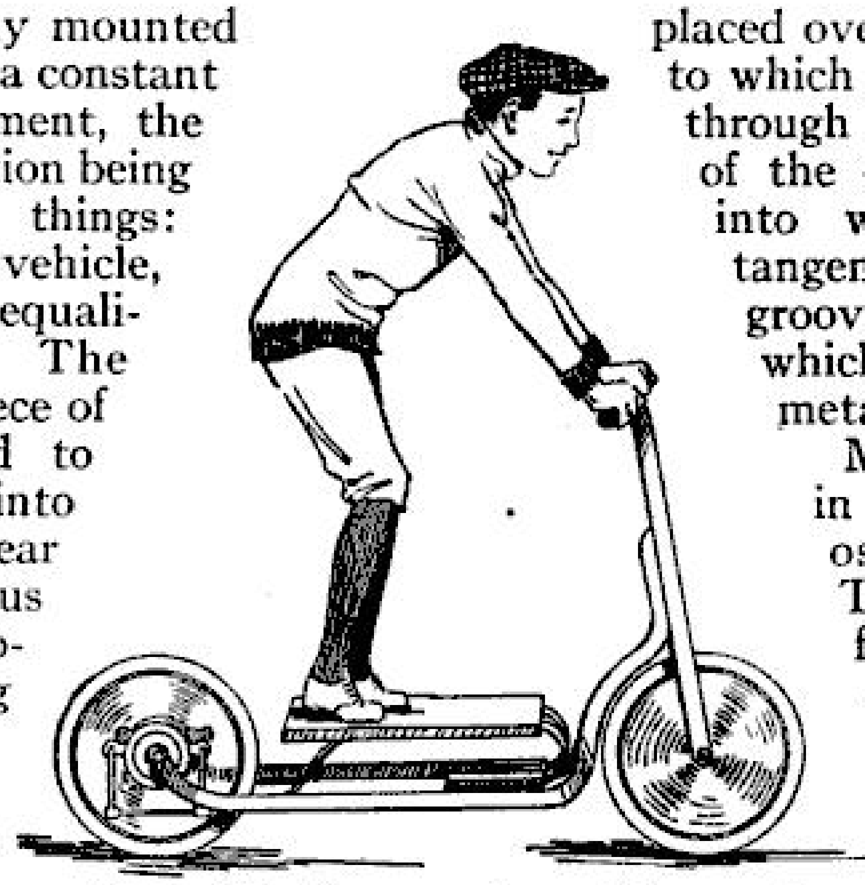
Renovating the Lawn

THE most effective way to renovate the old lawn is to make a new one. In most cases it will not pay to attempt to patch a poor grass plot for the difficulty probably is due to lack of proper soil conditions, and these cannot be satisfactorily remedied without an entire remaking of the lawn.

If the lawn is on a good soil and is merely disfigured with weeds, it can be brought into satisfactory condition by scratching the surface with a rake after removing the weeds, and seeding with well cleaned seed, using about one-half as much as for a new seeding. Bone meal, a complete commercial fertilizer and nitrate of soda may then be added with satisfactory results.

Weightmobile Approaches Perpetual Motion

A VEHICLE body mounted on springs has a constant vertical movement, the amplitude of the motion being dependent on two things: first, the speed of the vehicle, and, second, the inequalities of the road. The weightmobile is a piece of mechanism designed to convert oscillations into a continuous rectilinear movement, and thus greatly assist in propelling any moving body on wheels.

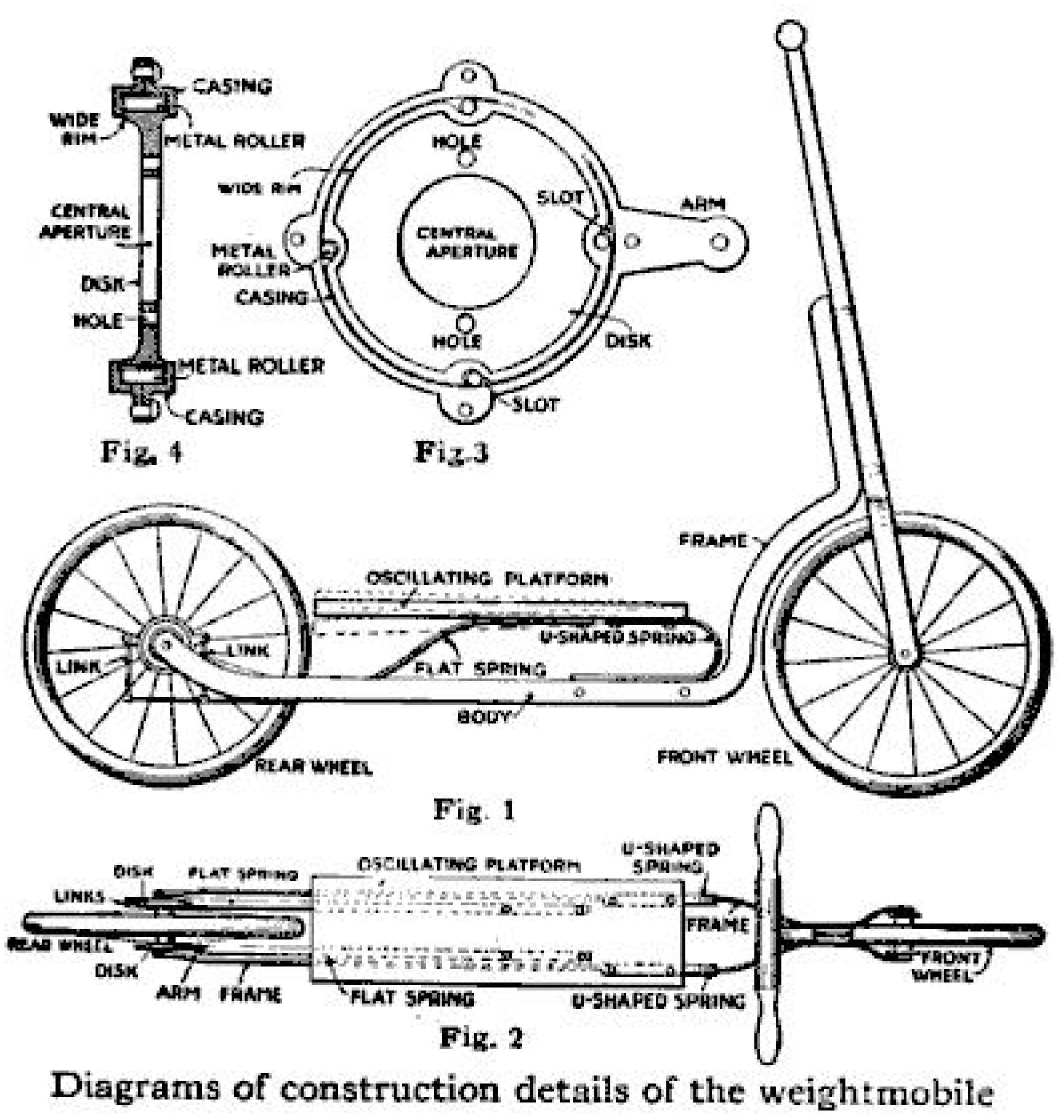


Every bit of energy is used to propel the push-cart

The manner in which this is brought about is shown in the accompanying drawings, which illustrate the power as applied to a boy's push-cart. Fig. 1 is a side view; Fig. 2 is a top view; Fig. 3 is a side view of one of the disks which is attached to the hub of the vehicle, and Fig. 4 is a cross-section of the disk, revealing its interior construction.

The little push-carts, as now made, comprise the front and rear wheels and body. It is not necessary to make any changes in these elements. The additions required are to provide the hub of the rear wheel with one of the disks at each end of the hub. The disk in Figs. 3 and 4 consists of a central aperture which permits it to be placed over the end of the hub, to which it is secured by bolts through holes. The perimeter of the disk has a wide rim into which are cut four tangentially-disposed cross-grooves, or slots, each of which is provided with a metal roller.

Mounted on the frame in Figs. 1 and 2 is an oscillating platform. This is secured to the frame by means of two U-shaped springs, enabling its rear end to move up and down a limited distance. A pair of flat springs is secured to the lower side of the platform, and their rear ends project back to points directly above the arms of the respective disks on the rear hub. The arm of one disk projects to the front, while the arm of the other points to the rear. Links between the ends of the flat springs and two disk-arms provide a means for imparting the oscillating motion of the platform to the arms of the disks.



Diagrams of construction details of the weightmobile

The tendency of bouncing up and down produces an oscillating motion which is applied to the disks in such a manner that the vehicle is propelled whether the platform moves up or down.

Trend of Motor-Truck Design Toward Worm Drive

MORE than sixty per cent of the American motor-trucks listed on the market at the present time are worm-driven. Last year twenty-two per cent of the trucks listed were worm-driven, thus showing that the popularity of this form of drive has increased.

To understand the reason for this great increase, one must first know the cause for any form of gearing for transferring the power of the truck motor to the rear wheels in order to make the truck move. The average gasoline motor of the truck of today revolves at the rate of from 1,000 to 2,000 revolutions per minute. It is out of the question for the rear wheels to revolve at any such speed because they would simply spin around and not secure enough traction between the tires and the ground to make the vehicle move. The necessary reduction between the speed of the motor and that of the wheels under varying conditions of roads is secured through some form of change-speed mechanism and the form of gearing used between the motor-shaft extended and the axle of the driving-wheels.

The latter type of gearing may be divided into four main classes as shown

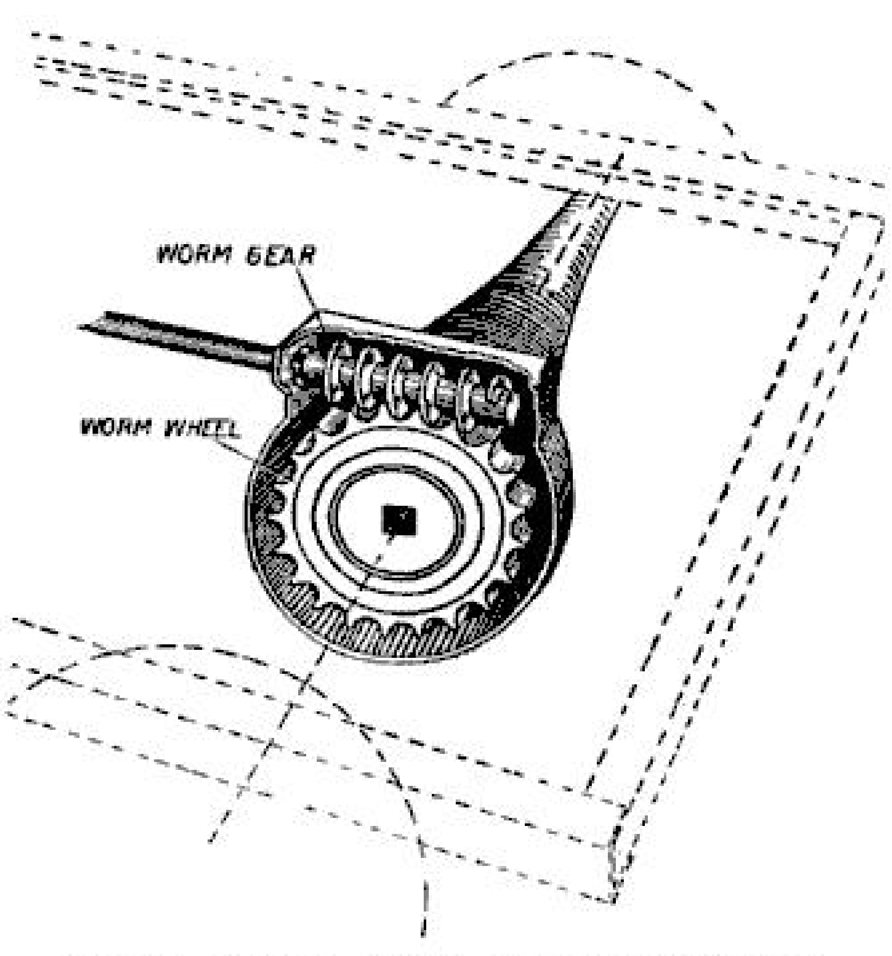


Fig. 2. Worm drive. The bevel-pinion and wheel are substituted by a worm-gear and worm-wheel

in the accompanying illustration, although there are some few other types used on special vehicles. The four most common types are: 1, Bevel drive; 2, Worm drive; 3, Double-chain drive, and 4, Internal-gear drive.

In the bevel drive the power of the motor is transmitted through the clutch

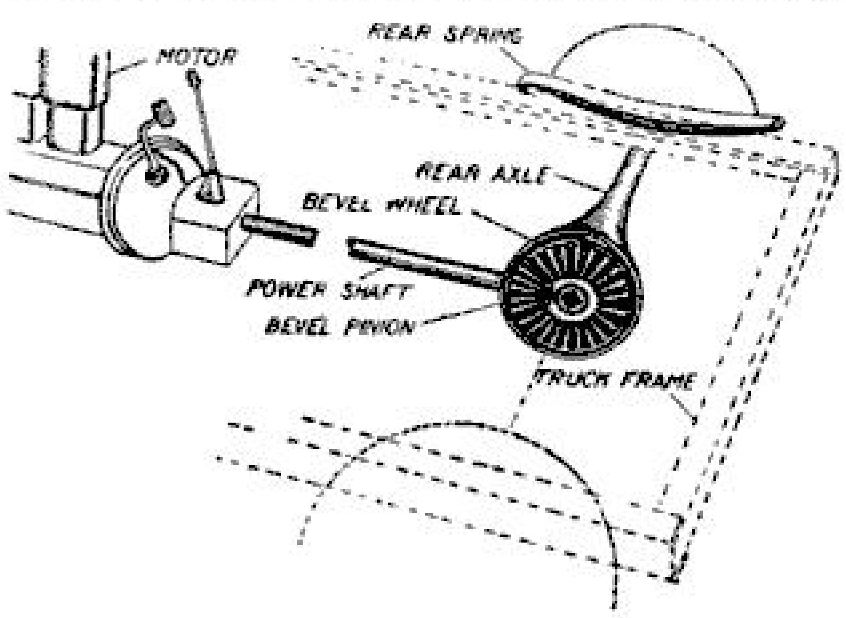


Fig. 1. Bevel drive. The bevel-pinion on the end of the shaft meshes with a large bevel-wheel in the rear

and change-gear mechanism to a longitudinal shaft at the rear end of which there is mounted a bevel-pinion. This meshes with a larger bevel-wheel to which are connected the ends of the rear wheel axles. When the bevel-pinion is made to revolve, the bevel-wheel revolves, which in turn sets the wheels in motion and causes the vehicle to move. This construction is shown in Fig. 1.

The method of worm drive shown in No. 2 is exactly the same except that a worm-gear and worm-wheel are used instead of a bevel-pinion and wheel.

The double-chain-drive method is based upon the same principle as the former methods except that instead of the extended motor-shaft reaching the rear axle of the truck, it ends at a rear-axle unit or jackshaft attached to the frame forward of a stationary axle on which the rear wheels are mounted. The jackshaft is the same as the rear-axle unit shown in No. 1 except that instead of having wheels mounted on the ends of its shaft, it has sprockets. Endless chains are passed around these sprockets

to two other larger sprockets, one bolted to each of the rear wheels of the truck. The motor power is thus transmitted to the jackshaft, to the jackshaft sprockets and thence through the chains to the rear wheel sprockets.

The internal-gear drive method shown in No. 4 also employs a jackshaft but this, instead of being mounted on the truck frame, is made into a unit with a stationary axle carrying the rear wheels. The wheels are revolved through small pinions positioned on the ends of the jackshaft which mesh with large internal gears bolted to the rear wheel spokes.

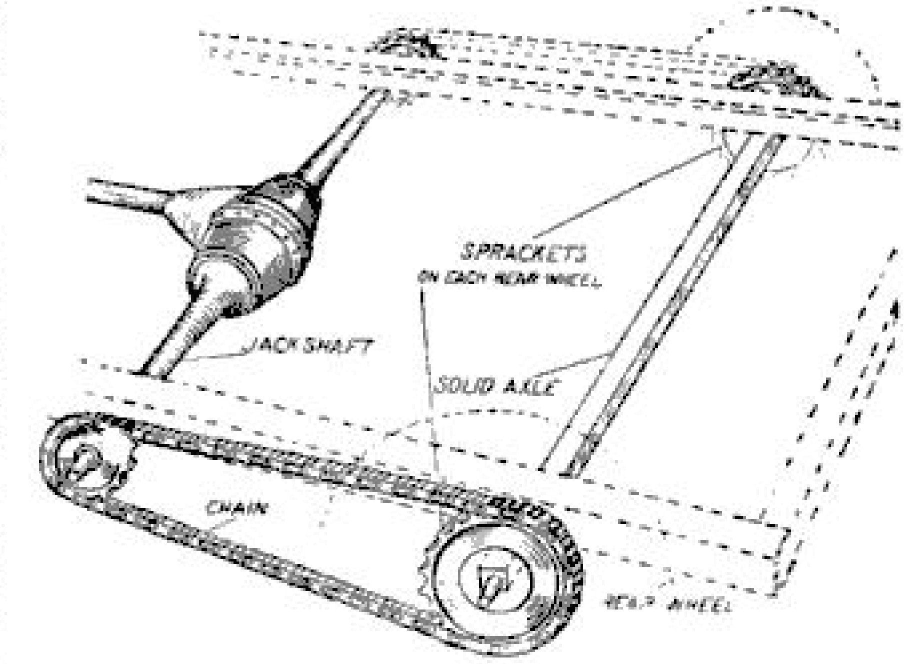


Fig. 3. Double-chain drive. The motor-shaft ends in a jackshaft which transmits the power to sprockets connected by chains

The bevel drive is used mostly on trucks of one-ton capacity and under. It is not used on larger trucks because the greater gear reduction necessary due to the greater weight of the truck and its load would make the bevel-pinion too small or the bevel-wheel too large for practical purposes. This necessarily larger gear reduction is secured by means of the double-chain drive by making the driving-wheel sprockets much larger than those on the jackshaft.

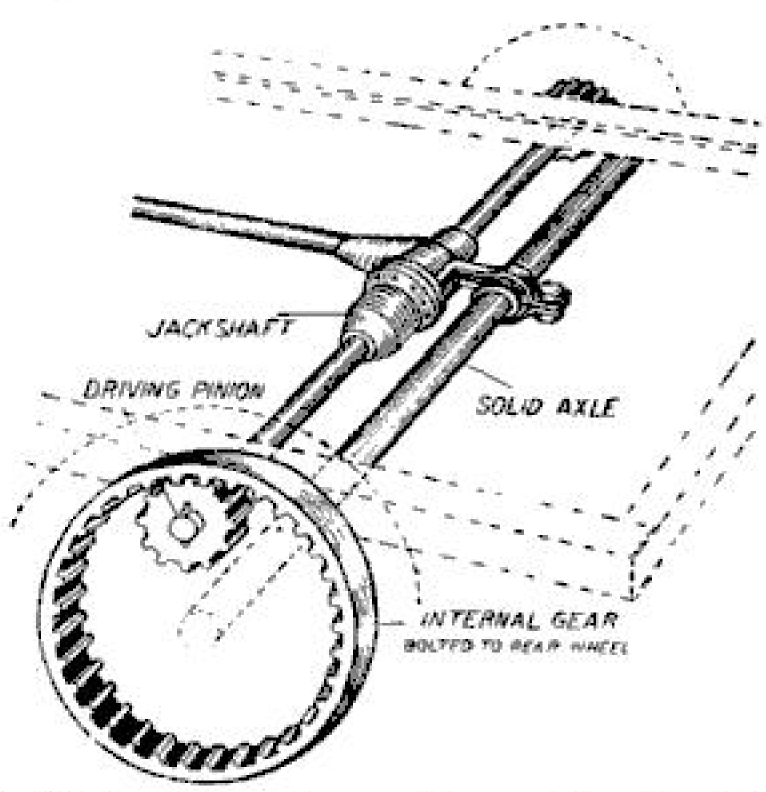


Fig. 4. Internal-gear drive. A jackshaft pinions with two large meshed wheels on the back axle

On the other hand, the necessary gear reduction for larger than one-ton trucks can be secured by means of the worm and worm-wheel due to the design of the worm-teeth and its rubbing instead of rolling action on the worm-wheel. It is also more efficient than the bevel or double-chain methods and delivers more power to the rear wheels because of the elimination of much of the friction of the bevel-pinions and chains. It also has the advantage over the double-chain method in being an enclosed drive, like the internal-gear type, thus preventing dirt and grit getting on to the driving members, and causing loss of power and excessive wear.

Another advantage of the worm drive over both the chain and internal-gear types is that the aggregate parts weigh less than either. This lightens the truck, permitting more of the motor power to be used for hauling the load to be carried instead of moving the heavy vehicle itself.

Measuring Rainfall on the Farm

AN excellent equipment for collecting and measuring either rain or snow consists of a simple pail or bucket. The location selected for setting out the pail should be in some open lot or field unobstructed by large trees or buildings. If the diameter of the pail is just 10½ ins. at the upper edge, each ounce of water collected represents 0.02 in. of rainfall. The pail should hold twelve quarts, in fact, most twelve-quart pails are exactly 10½ ins. at their upper edge. The depth of the rainfall, as shown by the water caught, may be found by weighing the contents of the pail. An ordinary small balance which reads in ounces and half-ounces is suitable for the purpose. In hot weather, when water evaporates quickly, the record should be made as soon as the rain has stopped, if possible.

We Paid Six Dollars

For These Two Pictures

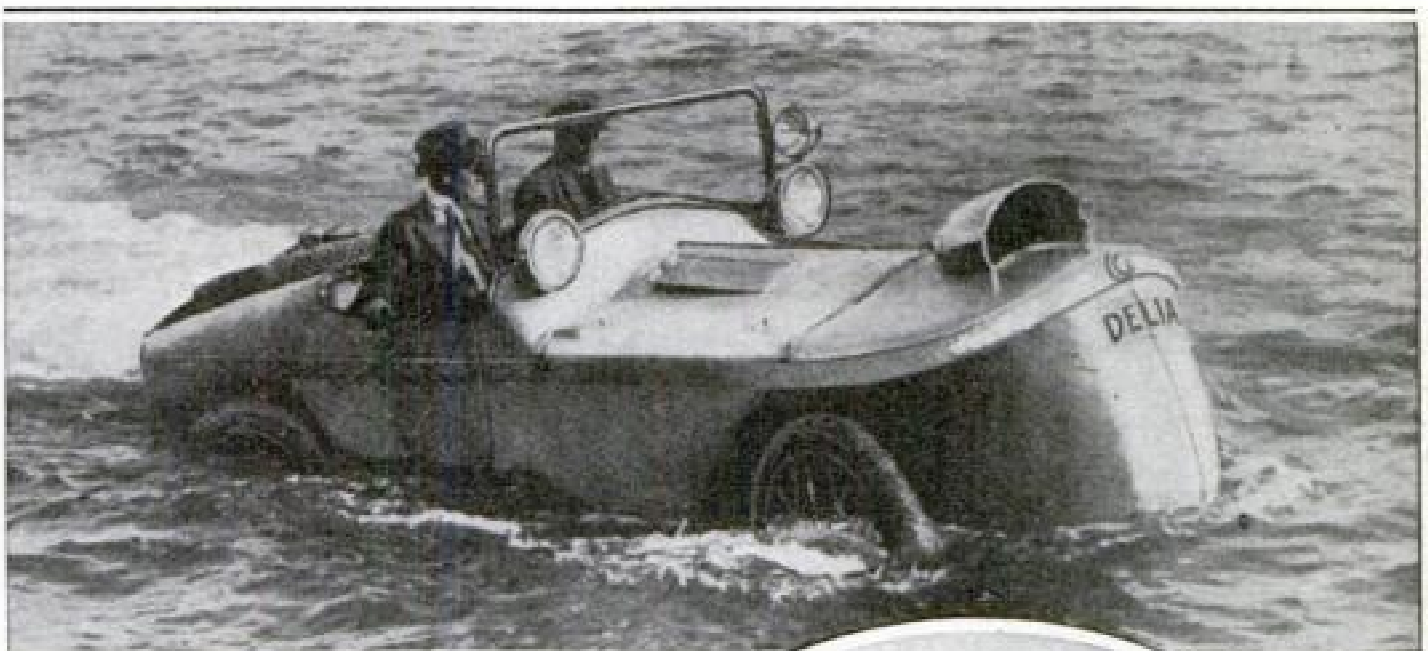
Of course you recognize Delia, the motor duck, which appeared in our March issue.

We want more photographs of equally interesting inventions, and we will pay for them at the rate of $3.00 each. The more daring the invention, the better for us.

But, Let the Picture Be Alive

Let a man or a woman appear in it doing something useful in connection with the machine. Dead machinery is not interesting.

Look about you for curious applications of old machinery. The automobile, for instance, is used for many purposes.



Things You Can Do with an Automobile

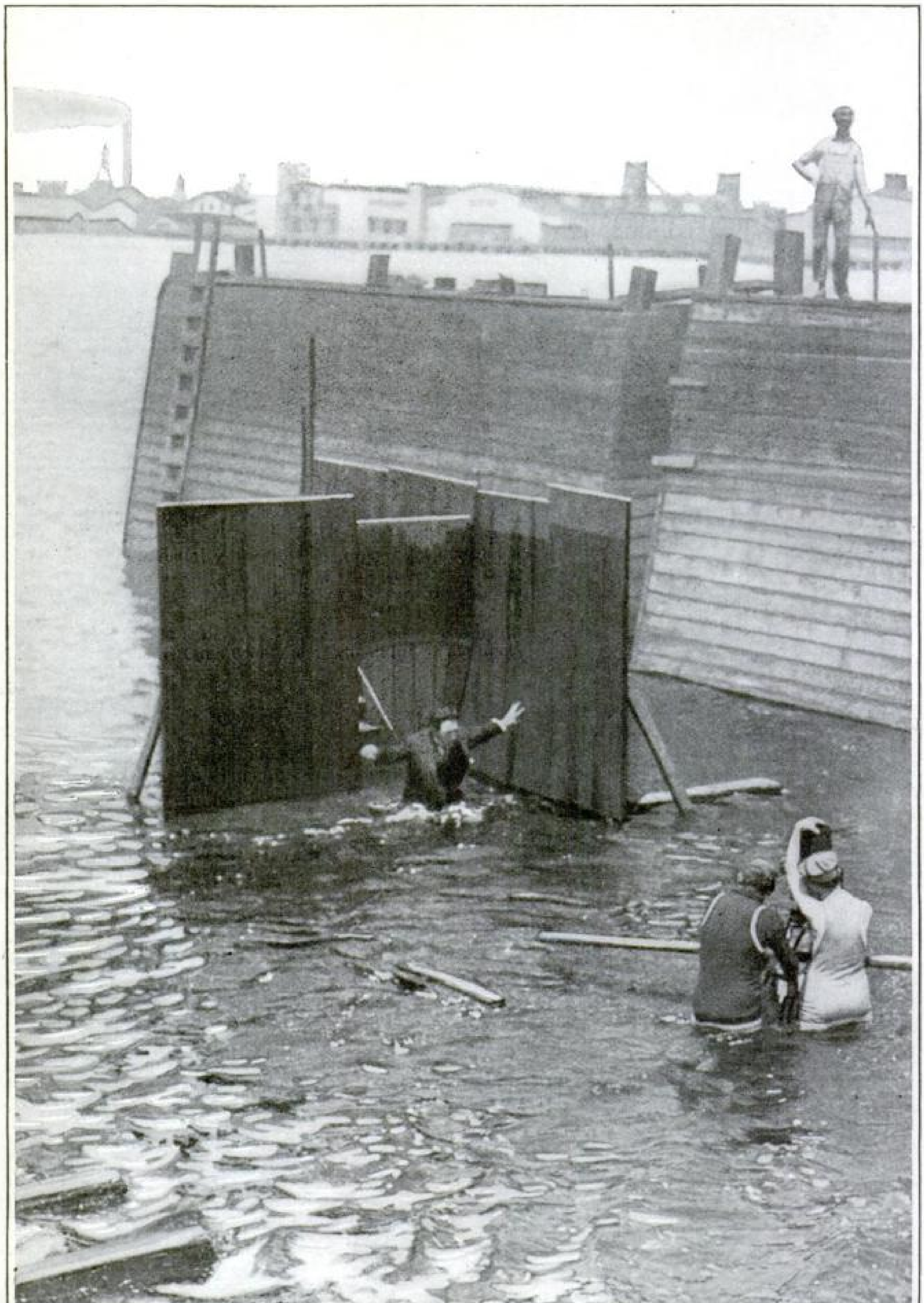
We know of one very resourceful man who uses an automobile to control a captive balloon. He simply jacks up the rear wheel and connects the axle with a winch. We know of another man who once lit up a church with his electric car in an emergency.

And we know of a third who ran a whole printing press with an automobile when the steam engine of the plant broke down.

Whether it is a telephone, a threshing machine, a safety razor or a grand piano, send us a picture of it if the device is doing something unusual.

Queer Ways of Making a Living

By the way, we are getting up a collection of photographs to be published under the general title "Queer Ways of Making a Living." Perhaps you would like to contribute some snapshots to the collection.—The Editor.



The intrepid hero comes downstairs just off the Jersey shore and finds the Hudson River wallowing in his reception parlor. Fearlessly, at the command of the director, he jumps in the water and ploughs knee-deep through Hoboken mud while the camera clicks